FINAL DRAFT

HEALTH AND SAFETY

GENERAL PLAN REVISION PROGRAM

COUNTY OF SOLANO
CITY OF FAIRFIELD
CITY OF VACAVILLE
CITY OF SUISUN CITY

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October 1985

HEALTH AND SAFETY ELEMENT - INSERT

The following are official amendments to the Health and Safety Element that have been made by the Fairfield City Council since the Element was adopted. Underlining indicates language that has been added to the original text. Strike marks (///) indicate language that has been deleted from the original text.

o Amendments adopted by City Council Resolution 82-288, December 7, 1982:

a. Revise policy 1, page 4 to read:

"Type A lands shall be restricted to open space uses only, such as extensive agriculture and outdoor recreation, and to structures, auxilary to those uses, except that wind turbine generators and their support facilities may be located in such lands provided that the following actions are accomplished: (a) a detailed geologic and soils study, prepared by a certified engineering geologist to determine suitable location of structures or roads, and (b) identified geologic and soils hazards are minimized through avoidance, corrective engineering measures, and/or special foundation design. "All secondary roads and utilities which support allowed land uses shall be privately maintained."

Revise Policy 4, page 23 to read:

"The introduction of any fixed point, permanent, non-residential, noise-emitting land use (industrial, commercial, public utility, etc.) shall be prohibited if the projected noise emission level" ~~will exceed one or more of the following:~~

~~a.~~ ~~50 dBA CNEL as measured at the boundary of a nearby residential or agricultural zone.~~

~~b.~~ ~~60 dBA CNEL as measured at the boundary of a nearby commercial zone, business zone (personal services, offices), or noise-sensitive industrial or manufacturing zone (research, communications, etc.)~~

would cause the levels on any adjacent property ~~land use~~ to exceed the standard for acceptable land use as established ~~for that type of use, as shown on~~ by Table 1.

- o Amendment adopted by City Council Resolution 85-99, April 16, 1985:

  1. Amend p. 17 to read as follows:

     Very Low Density Residential development may be permitted in areas of high wildfire risk provided that the development plan contains effective fire protection measures such as consolidation of fuel buildup abatement, fire break maintenance, fire fighting equipment access, water service provision, and other measures deemed appropriate.

2. Residential development shall be limited to a maximum of one dwelling unit per every five acres of land in areas of high wildfire risk. (Although the prevalent land use designation in these areas restricts development to 20 acre densities, certain subsections of these areas are desgnated in current plans for inappropriate densities and uses.)

3. The county and cities shall require grouping of residential units to provide for more localized and effective fire protection measures such as consolidation of fuel buildup abatement, fire break maintenance, fire fighting equipment access, and water service provision, and a more manageable localization or focus of any actual fire-fighting activity. (This would also serve to minimize extensive fuel buildup abatement which could be costly and inconsistent with open space and scenic protection policies of the general plan.)

FINAL DRAFT
GENERAL PLAN REVISION PROGRAM

HEALTH AND SAFETY

Prepared for the

COUNTY OF SOLANO
CITY OF FAIRFIELD
CITY OF VACAVILLE
CITY OF SUISUN

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INTRODUCTION

PURPOSE

Significant portions of land within the Solano County, Fairfield, Vacaville, and Suisun City planning areas are subject to a variety of natural and man-induced hazards related to soil instability, seismic activity, flooding, fire, and noise, which threaten community health and safety. The purpose of this health and safety element is both to identify the areas where such hazards to life and property occur and to provide development and protection policies which specifically respond to those hazards. The element will guide the county and participating cities in deciding what types of land uses shall be permitted or promoted in various areas, how and where to build public facilities, and which type of public services should be provided.

The element is specifically designed to provide the county or cities with a basis for controlling the actions of private individuals or firms and other public agencies who use or propose to use planning area lands. It is structured to be particularly useful in providing both public and private entities involved with the environmental impact assessment (EIR) process with clear direction with regard to the priority of issues which must be addressed for any particular site in the planning area.

These general plan provisions are primarily meant to address further development in the urban and suburban areas of the county where hazards have the greatest potential effect in terms of public safety and dollar loss from damage to property and urban support facilities. For the most part, the provisions herein do not apply to less intensive activities such as agriculture unless such rural lands are proposed for conversion to an urban or suburban land use pattern. These provisions apply to structures associated with agricultural and other open space uses only where a severe and direct hazard to life or property is involved. For example, construction of a farm residence directly atop an active fault is prohibited.

Finally, this health and safety element enables the county and cities to fulfill the following legal obligations as set forth in State Planning Law: (1) Government Code Section 65302 (f) which requires the preparation of a seismic safety element identifying and appraising seismic hazards, (2) Section 65302 (g) which requires the preparation of a noise element identifying present and projected noise levels and compatible land use policies, and (3) Section 65302.1 which requires the preparation of a safety element for the protection of the community from fires and geologic hazards. In addition, this element provides the county and cities with an analysis and policy response to flood hazards in the planning area as authorized by Government Code Section 65302 (d).

FORMAT

The element is organized in order of its likely use. Specific policies for land use which are the primary ingredients of the element, comprise the first section. They are followed by a second section which outlines methods for implementing the specific land use policies. And the final section consists of a detailed identification and evaluation of existing conditions in and around the planning area which constitute hazards to life and property and are the basis for the various specific policy responses.

SPECIFIC POLICIES

In formulating these policies, judgements were made in regard to the levels of unacceptable risk above which specific action by government is deemed necessary to protect life and property. The realization of a completely hazard-free environment through adoption of new general plan provisions is highly infeasible, particularly in areas which are already partially urbanized. Natural and man-made hazards of some kind are always present. On the other hand, reasonable measures can and should be taken to mitigate the consequences of identified hazards.

Establishing appropriate degrees of development control involves the recognition of the presence of a hazard, evaluation of its likely severity and frequency, and the characteristics and values of the area involved. Provisions formulated in this element implicitly take into account the cost versus the benefits of different hazard prevention measures and acknowledge the intangibles involved.

SEISMIC AND GEOLOGIC HAZARDS

SLOPE INSTABILITY

Severe slope instability hazards are known to exist in certain Fairfield, Vacaville, and unincorporated Solano County areas. The specific policies enumerated below respond to the levels of hazard associated with two zones and degrees of slope instability, Type A and Type B areas, as designated on Figure 1 and defined as follows:

Type A Lands. Type A lands are almost exclusively those classified in Slope Instability Category 5, areas composed mainly of existing landslide deposits, and Category 4, areas highly susceptible to future landsliding. Both categories are described in detail on page 34 and are mapped on Figure 10. Although there may be small, isolated pockets of more stable land within areas designated as Type A, road and utility access to these more stable areas would have to cross unstable lands.

Type B Lands. Type B lands consist of areas where there are extensive portions classified in Slope Instability Categories 5 and 4, but where there are also large areas of more stable land which may be safely accessible for development purposes.

An exceptionally wet winter, an earthquake, or even seemingly minor changes in ground conditions caused by development, could trigger major landsliding in these designated areas. If unrestricted development were to occur on Type A and B lands, slope instability conditions, related hazards to life and property, and the likelihood of additional public expenditure to maintain utilities and roads, would be increased.

Specific Policies

Any development on Type A or Type B lands shall be subject to the provisions which follow:

1. Type A lands shall be restricted to open space uses only, such as extensive agriculture and outdoor recreation, and to structures auxiliary to those uses. All secondary roads and utilities which support allowed land uses shall be privately maintained.

2. Construction of new public roads and utilities shall not be permitted on Type A lands unless no alternative routes are possible. In the latter event, special construction precautions shall be taken to minimize hazards and maintenance costs.

3. The county and cities should adopt a land capacity ordinance for Type B lands which will set allowable densities based on the actual amount of buildable land. Lands in Slope Instability Categories 5 and 4 (see page 36 and Figure 10) would be considered in the ordinance as unbuildable. The land capacity ordinance should require submittal by the applicant of the results of a detailed site analysis including soils, geologic and seismic data, by a geologist registered in this state with certification in engineering geology.

4. The county and cities should retain a geologist registered in this state with certification in engineering geology, to review all development applications involving Type B lands where geologic conditions warrant special attention. Costs of such consulting services as they relate to a specific development proposal shall be incurred by the applicant.

5. Any subdivision, minor or major, for urban or suburban purposes[1] of Type B land shall be included in a special landslide prevention and maintenance district, or shall be required to comply with a more stringent set of engineering standards for structures, roads, and utilities, such as:

   a. Requirements for structural foundations specifically designed to accommodate stresses and strains associated with minor ground movement (soil creep, etc.). For example, use of pier grid or mat foundations might be considered as preferential to minimum UBC standards.

   b. Further restrictions on grading, limiting excavation to those operations which enhance ground stability without drastic site modification.

   c. Special surface or subsurface drainage requirements intended to improve the factor of safety against ground movement or failure.

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[1] The term "suburban" refers herein to structures for human occupancy on parcels of five (5) acres or less.

FIGURE 1
SEISMIC AND GEOLOGIC HAZARDS

SLOPE INSTABILITY

- TYPE A CATEGORY - Predominantly lands highly susceptible to landsliding
- TYPE B CATEGORY - Extensive landslide-prone areas intermixed with more stable soils

SURFACE FAULTING - ACTIVE FAULT TRACES

- KNOWN
- ALQUIST/PRIOLO ACT SPECIAL STUDIES ZONE BOUNDARY
- INFERRED
- CONCEALED

SURFACE FAULTING - FAULT TRACES OF UNKNOWN ACTIVITY

- KNOWN
- INFERRED
- CONCEALED
- ? UNCERTAIN

GROUND SHAKING

- LOCATION OF PRE-1933 TWO STORY (+) MASONRY STRUCTURES

GROUND FAILURE - AREAS SUBJECT TO LIQUEFACTION

- BAY MUD
- PRIME AGRICULTURAL SOILS WITH HIGH WATER TABLES

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d. Requirements for adequately detailed geologic and soil engineering investigations in the field and laboratory and special geotechnical or structural design analysis where evidence indicates that conventional development practices may not assume trouble-free performance.

6. For those Type B lands where development seems imminent, the county and cities should consider preparation of more precise or specific area plans as described on page 27.

SURFACE FAULTING

Geologic evidence indicates that the planning area is traversed by a number of faults (i.e., fracture zones in the earth's crust along which there has been displacement). Any surface displacement in excess of a few inches along one of these faults occuring beneath a building, transportation facility, main utility line, aqueduct, etc., could cause serious structural damage to overlying facilities.

Known fault traces in the planning area are indicated on Figure 1. Some are considered active, i.e., capable of displacement in the near future. The activity of others remains unknown.

Hazards associated with current land use policy and planning area fault traces are indicated on Figure II. Hazards associated with major utility alignments and fault traces are shown on Figure 12.

Specific Policies

The following provisions address hazards associated with potentials for surface faulting:

1. No structure for human occupancy, other than one-story wood frame structures, shall be permitted within one hundred (100) feet of an active fault trace as designated on maps compiled by the State Geologist under the Alquist-Priolo Geologic Hazards Zone Act, (or 50 feet for one-story, wood frame dwellings).

2. The county and cities shall require that any proposals for a major subdivision or for a facility which attracts numbers of people, is open to the general public, or provides an essential community service, which fall within one quarter mile of a known, concealed or queried fault, shall be subject to one of the following requirements:

a. The proposal shall be accompanied by a detailed site investigation by a geologist registered in this state with certification in engineering geology. The investigation shall locate all surface fault traces within 100 feet of any proposed structure and determine their relative activity, using trenching and geophysical methods as necessary. Proposals shall also include adequate provisions for mitigating the hazard potentials to human life and property due to displacement of any identified fault trace.

b. The county or city could choose not to approve any development applications until it prepares a more precise or specific area plan, as described on page 28 for the subject area which includes detailed mapping of active or potentially active fault traces and recommends appropriate planning and engineering measures to mitigate related hazards.

3. The county and cities shall treat the northern extensions of the Green Valley fault (north of the Green Valley Creek) as potentially active. No structures for human occupancy shall be located within one hundred and fifty (150) feet of these designated fault traces unless a geologic investigation by a geologist registered in this state with certification in engineering geology shows that no active fault trace occurs within one hundred (100) feet of the proposed structure (or 50 feet for one-story wood frame dwellings).

4. The county and cities should retain a geologist registered in this state with certification in engineering geology, to evaluate the geologic reports required herein where seismic conditions warrant special attention.

5. All existing and proposed highway construction which falls within an Alquist-Priolo Act Special Studies Zone shall be reviewed to ensure that grade-separated interchange structures are not located on or near an active fault trace.

6. Crossing of a Special Studies Zone by new public and private transmission facilities, including power and water distribution lines, sewer lines, gas and oil transmission lines, shall be restricted by the cities and county. If there are no reasonable alternative alignments, facility design must be satisfactorily shown to include sufficient provision for valves, switches, and other equipment appropriate to insure minimum adverse impact to surrounding development from fire, disruption or continuity of service, spillage, etc., as a result of fault displacement.

7. Any existing facility which is located within the boundary of a Special Studies Zone and attracts numbers of people, is open to the general public, or provides essential community services, shall be investigated by a structural engineer licensed in this state for potential hazards to life and property due to fault displacement. The cost of such investigations shall be incurred by the building operator. If hazards are identified, appropriate hazard mitigation actions, subject to city or county approval, shall be taken.

8. The cities and county shall determine what natural gas wells feed pipelines which cross any Special Studies Zone (Alquist-Priolo Geologic Hazards Zone Act) and whether or not those wells or their associated pipelines are equipped with pressure-operated safety valves, chokes, or other devices capable of automatically shutting off gas flow in the event of pipeline rupture due to fault displacement. Owners of those particular wells and pipelines shall be required to install adequate emergency shut-off devices on wells or pipelines which are not already so equipped.

9. The city or county shall require owners of all existing oil, gas, water and sewer pipelines which cross active faults to file with the city or county an operations plan describing the probable effects of pipeline failure at the fault and the various emergency facilities and procedures which exist to assure that failure does not threaten public safety.

10. Secondary or contingency earthquake disaster evacuation and aid routes shall be planned by the cities and county in coordination with the Emergency Services Office, as alternatives to those currently-designated principal evacuation routes which cross active fault traces (see Figures 1 and 12).

11. The county and cities should investigate the possibility of coordinated efforts at gathering geologic data on those faults of unknown activity near urbanizing areas, with HUD-USGS or the State Division of Mines and Geology.

12. The county and cities shall initiate a joint data collection program to accumulate geologic information relevant to development review and planning purposes, for all faults which are in proximity to developing areas (Green Valley, Vaca Valley, Lagoon Valley, Kirby Hills fault, etc.). A duplicate file shall be established in each of the participating planning departments for storage of all reports, maps, and other pertinent data. To ensure its use and completeness, reference to the file shall be required as part of normal development review procedures. The file will be particularly useful for reviews of those preliminary development proposals which may require accompanying geologic reports, since certain investigation requirements could be waived where adequate, detailed information on an area is already on file.

SEISMIC SHAKING

Seismic shaking is by far the greatest single cause of earthquake damage. Solano County has had a history of earthquake shaking which spans more than 150 years and has often involved casualties and severe property damage. It is clear that the county is in an area of relatively high seismicity. No part of Solano County will be free from the effects of future seismic shaking.

Specific Policies

All Solano County, Fairfield, Vacaville, and Suisun City land use shall comply with the seismic shaking-related policies enumerated below. Reference should also be made to those specific policies which respond to particular effects of seismic shaking, i.e., slope instability, ground failure, and dam and levee failure inundation.

1. All new buildings shall conform to the latest seismic structural standards of the Uniform Building Code as a minimum standard. In addition, since UBC standards do not guarantee against significant seismic damage and do not consider the varying underlying geologic conditions of a particular site, plans for buildings subject to public occupancy other than single-story woodframe structures and one- or two-family woodframe dwellings,

(a) be accompanied by an investigative report prepared by a geologist registered in this state with certification in engineering geology, which identifies underlying geology and recommends structural measures necessary to adequately resist the level of seismic response associated with the underlying geology, and (b) shall be signed by a civil or structural engineer registered in this state.

2. Since human safety is currently most threatened by structural hazards in existing buildings, the county and cities shall institute a comprehensive seismic hazard abatement program which should include the following inspection and enforcement measures:

a. The structural condition of all pre-1933 masonry buildings which are used for assembly types of purposes , or provide essential community services, shall be investigated by a structural engineer licensed in this state for potential threats to public safety. Such investigations shall be the responsibility of the building operator. If hazards are identified, structural upgrading to quake-safe standards shall be undertaken or such occupancy shall be discontinued.

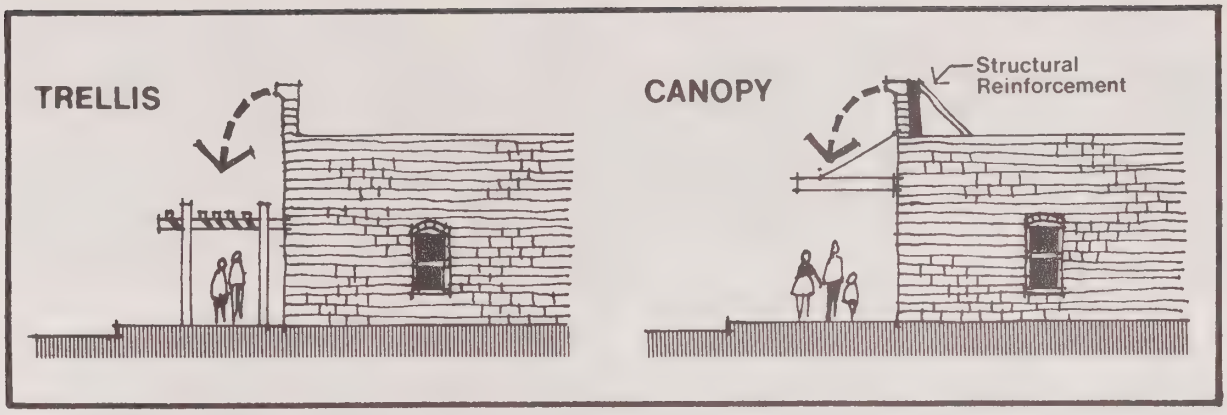
b. Upon termination of present use or application for zoning change, approval of any new use of a pre-1933 masonry building which will involve human occupancy shall be subject to investigation for structural adequacy under seismic loading. If hazards are identified, approval of the new use shall be contingent upon structural upgrading to quake-safe standards.

c. Variances from these quake-safe structural requirements may be allowed for one-story structures except when used for assembly types of purposes.

d. Parapets, signs, and other appendages on all buildings in active commercial and industrial areas shall be inspected by a structural engineer licensed in this state for stability under seismic loading. Such inspections shall be the responsibility of the building operator. Adequate reinforcement or removal shall be required as necessary to mitigate identified hazards.

e. Where compliance with such hazard abatement requirements will necessitate demolition or drastic modification of the character of a building of significant visual or historic value, the county and cities shall take cooperative action to encourage the retainment of those structures or features. For example, one of the following measures might be considered in lieu of standard hazard abatement requirements:

-Provision of tax incentives or low interest loans to encourage structural repair or reinforcement in lieu of removal or demolition.



-Construction of a trellis or overhang which would be architecturally compatible with the subject structure and would be of sufficient strength to break the fall of a collapsing parapet.

3. All creekside construction except farm structures under 3,000 square feet in ground area which are not dwellings or places of work, shall be subject to minimum setback requirements between creek bank and structure based upon the susceptibility of the bank to seismic shaking-induced lurching. In the absence of specific geologic and soils data, minimum horizontal setback from the creek bank shall be taken to be two times the height of the creek bank.

GROUND FAILURE

Ground failure resulting from earthquake-induced soil liquefaction is an important risk threatening existing and future urbanization in Solano County. Saturated granular materials in liquefaction-prone soils can be transformed by seismic shaking into a fluidlike state, causing ground failure and consequent structural damage to buildings,roads, pipelines, transmission towers, railroad tracks, etc.

Soil layers with high liquefaction potential are particularly common in those county areas of existing and former marshland underlain by saturated bay mud and where prime agricultural soils are combined with high water tables. Liquefaction potential in the central and eastern portions of the county has increased in recent years due to a ground water table rise brought about by the cessation of ground water withdrawal from wells tapping the area's extensive subsurface aquifer in favor of a new and less costly surface water source, the Putah South Canal.

Specific Policies

All lands which fall within the liquefaction-prone areas identified in Figure 1 shall be subject to the following provisions:

1. Appropriate site investigation shall be required at the outset for all projects proposed for areas identified as underlain by a combination of prime agricultural soils and high water tables and for all projects, except one- and two-family woodframe dwellings, proposed for areas underlain by bay mud. Investigations shall examine such factors as depth of water table, thickness and compressibility of bay mud, depth to bedrock, presence of layers and lenses of sand, technical description of any engineered fill, etc., and the structural design implications of these factors.

2. For lands confirmed by site investigation as prone to ground failure, the following special procedures shall be established for the remaining development review process:

a. All proposed site modifications, structures, roads, and utilities shall be carried out in accordance with the recommendations of a civil engineer licensed in this state.

b. The county or city shall retain an independent consultant to evaluate the site investigations and professional recommendations required herein. Costs of such consulting services shall be incurred by the applicant. (This extra precautionary step is considered essential since there are currently differing professional interpretations regarding the safeguards required in such areas. Such a procedure would give the Planning Commission and the Board of Supervisors or City Council the benefit of several professional judgements and would focus attention on any unresolved public safety issues. The Bay Area Conservation and Development Commission presently uses a similar procedure on bayfront lands. In this instance, they use a three-member technical committee to review development applications.)

3. In lieu of requiring independent site investigations, the county or city could choose not to approve any development applications until it prepares a more precise or specific area plan for the subject area which includes a thorough analysis of ground failure potentials and recommends appropriate planning and engineering measures to mitigate related hazards. Such studies would also provide an integrated and efficient means of environmental impact assessment. Plan preparation could be financed by groups of interested developers as part of the EIR process, or through special assessment district procedures.

4. In areas of prime agricultural land and high water tables where a lowering of the water table would protect valuable croplands or provide for safe and acceptable development, the county or cities should:

a. Encourage a return to ground water withdrawal for irrigation purposes through a program which would adjust the cost of well water to the user to a level below the cost of canal water.

b. Institute a program of ground water extraction in selected areas to lower the water table for crop growing and other land use purposes.

5. No new public or private power, water, sewer, or gas lines shall be permitted to cross ground failure areas unless reasonable alternative routes are not available or the facility design includes sufficient provision for valves, switches, and other equipment appropriate to ensure rapid shutoff, minimum disruption of service, and minimum adverse impact on adjacent and surrounding areas in the event of seismic-induced ground failure. Lines shall also be accessible for emergency repairs to minimize the potential for extended service interruption.

FLOOD HAZARDS

A large portion of developed and undeveloped planning area lands (30 to 40 percent) are subject to flooding due to a combination of conditions including periodic heavy winter rainfalls, tidal fluctuations, and potential for canal, levee, and dam failure due to seismic activity. These conditions are described in detail in this document under EXISTING CONDITIONS, pp. 46 to 73.

STORMWATER AND TIDAL INUNDATION

The control of watershed runoff and stream overflow is appropriately approached on a watershed basis with a coordinated set of both upstream and downstream land use policies. Upstream policies pertain to lands adjoining streams in the higher elevations and upper reaches of a watershed tributary system. Upstream areas are characterized by varying topography and steep stream gradients, with most slopes exceeding five percent. Downstream policies pertain to lands adjoining streams in the lowest elevations of a watershed, usually in flood plain areas. Downstream topography is predominantly flat, slow-draining, and in proximity to the bay. Downstream lands may also be subject, to tidal actions which compound flood problems from stormwater runoff.

By far the major portion of flood-prone lands in the planning area are downstream lands which are subject to inundation due to heavy rainfall, watershed runoff, and resulting stream overflows. The potential for downstream flooding is in large part directly related to upstream conditions. A number of streams in the area have long histories of seasonal downstream flooding, often resulting in significant property damage. Most of these floods, however, have not reached the disastrous levels that can be expected from a relatively rare 100-year storm. The estimated inundation area for such an event is mapped on Figure 2.

Upstream flooding, presently a relatively minor problem which can occur where a steep stream gradient flattens abruptly and/or where a channel's capacity is suddenly restricted, may also become a hazard, particularly to certain future upland land uses.

Specific Policies for Upstream Land Use

The following upstream land use and conservation policies serve to mitigate such storm-water inundation potentials by minimizing encroachment on natural drainage courses and increases in the rate of runoff caused by upstream land development:

1. The county and/or cities should undertake a precise hydrological analysis of study area uplands, identifying the different watersheds which drain into the planning area, establishing flood-related objectives and priorities on a study area basis, and translating those into a coordinated series of flood-preventive measures for each watershed.

2. Wherever possible, upstream watersheds should remain essentially devoted to open space land uses such as recreation and extensive agriculture (grazing).

3. The following upstream land use practices often contribute to increased rates of surface water runoff and should therefore be prevented or regulated:

   a. Overgrazing by livestock

   b. Logging, clearing, burning, and other activities which can reduce natural vegetative cover

   c. Construction of extensive impermeable surfaces (large developments which might include a number of structures, patios, dwellings, roads, etc.) over naturally permeable soil and geologic areas

4. Upstream land use controls shall be formulated to protect riparian corridors (the stream, its banks, and creekside vegetation) from encroachment and degradation by development.

5. No development shall be permitted which would interfere with existing channel capacity or would substantially increase erosion, siltation, or other contributors to the deterioration of any watercourse.

6. Integration of riparian corridors (the stream, its banks, and creekside vegetation) into park or trail systems and other common open space uses should be required as a condition for the development of adjoining lands for non-agricultural uses.

7. Where channel capacity is restricted, the county or city shall make channel and embankment improvements, providing that such measures do not conflict with adopted open space and conservation policies.

8. The county and cities shall provide periodic stream maintenance as necessary to clear channels of blockages by debris and silt buildup.

FIGURE 2
FLOOD HAZARD

AREAS SUBJECT TO STORMWATER AND TIDAL INUNDATION - 100 YEAR FLOOD PLAIN

AREAS SUBJECT TO INUNDATION DUE TO DAM FAILURE OR OVERSPILL

AREAS SUBJECT TO TSUNAMI INUNDATION

EXISTING CANALS AND AQUEDUCTS

PROPOSED CANALS AND AQUEDUCTS

PUTAH SOUTH CANAL

CACHE SLOUGH CONDUIT

NORTH BAY AQUEDUCT

AMERICAN AQUEDUCT

LAKE CURRY

LAKE MADIGAN

LAKE FREY

PENN CREEK

SUMMIT RESERVOIR

LAKE CHABOT

FLEMING HILL RESERVOIR

LAKE HERMAN

LAKE ZWANZY

PINE LAKE

SACRAMENTO

SAN PABLO BAY

GRIZZLY BAY

SUISUN BAY

MONTEZUMA HILLS

SUISUN ISLAND

Brannan Island

Twitchell Island

WEBB TRACT

FRANKS TRACT

BETHEL TRACT

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9. In those watersheds which are the major contributors to downstream flood problems, the county and cities should undertake or advocate the construction of upstream floodwater retention devices such as ponds (dams) and/or diversion channels.

The most widespread damage from stormwater flooding occurs, of course, in downstream areas where relatively flat topography is conducive to slower drainage and resulting inundation. The likelihood of downstream flooding is intensified by the potential for coincident high tides and strong offshore winds during periods of heavy fainfall. The hazards associated with downstream flooding are particularly severe since urbanization has a tendency to spread throughout the more developable flatlands of the county and cities, often encroaching upon floodplain surface areas.

Specific Policies for Downstream Land Use

The following policies serve to significantly reduce risk to human life and potentials for damage to homes, businesses, crops, roads, etc., associated with downstream flooding.

1. Primary flood plain zones (the stream channel and portions of the adjacent flood plain that carry the design flood flows of the stream) shall be protected and maintained through strict limitations on land use, road construction, and land fill. Land uses should be limited to non-urban, low capital investment types of uses.

2. Both the ground floor elevation of any building for human occupancy and the driving surface of designated evacuation routes within the 100-year flood plain as designated on Figure 2, shall be constructed above the projected profile of a 100-year flood event.

3. The county and cities should adopt road construction standards for areas designated as flood prone which allow for the passage of flood water under the road surface unless a diking effect is desired.

4. The county and cities should require that all new and existing development for human occupancy within the 100-year flood plain as designated in Figure 2 be adequately flood-proofed. Specific flood-proofing measures may include permanent sealing of grade level openings; use of paints, membranes, or mortar to reduce water seepage through walls; installation of watertight doors, bulkheads, shutters, and similar closures; installation of floodwater pumps in structures; proper modification or reinstallation of all electrical equipment, circuits, and appliances so that they are protected from inundation by a 100-year flood.

5. The county and cities should implement those flood control and drainage improvement recommendations included in locally-formulated plans, and should advocate those recommendations made by the U. S. Army Corps of Engineers and the Reclamation Board

of the State of California, which do not conflict with locally-adopted open space and conservation policies regarding natural water course preservation.

TSUNAMI AND SEICHES

The portion of the planning area which is subject to inundation by tsunami is minimal, as shown on Figure 2. However, should these lands come under pressures for development, and development proposals are compatible with scenic roadway policies, the following provisions shall apply:

Specific Policies

1. Any structures permitted within areas designated as prone to tsunami inundation shall be adequately anchored to resist flotation or lateral movement.

2. The ground floor elevation of any structure for human occupancy, if permitted within areas designated as prone to tsunami inundation, shall be constructed above the projected flood profile level.

DAM FAILURE

There are some 18 dams in Solano County which are currently retaining water. Of these, the State of California Office of Emergency Services has, as required by law, identified eleven of the 18 dams whose failure may cause injury or loss of life. The O.E.S. has prepared maps indicating the inundation area assuming failure for ten of the eleven dams. An identification of the inundation and failure characteristics of the eleventh facility, the Putah Creek Diversion, has not yet been submitted by the facility's owner, the Bureau of Reclamation.

Maps of dam inundation areas are based on the structural type of each dam and its dam failure characteristics, i.e., the likely rapidity and degree of failure and inundation. These O.E.S. maps are summarized on Figure 2. Eight dams in the county (see Table 8) were exempted by the O.E.S. from the inundation mapping program since no injury or loss of life was anticipated with failure.

Specific Policies

The following provisions respond to the potential flood hazard to human life and property should any of the 18 dams in the planning area fail:

1. An EIR should be required for all proposals for development involving human occupancy which fall within dam failure inundation areas as designated on Figure 2. The EIR should include a report detailing the results of a dam safety investigation.

2. An EIR should be required for all proposals for development involving human occupancy which are judged by the county or cities to be within the inundation area of a water retention facility which has been exempted from the O.E.S. inundation mapping program. The EIR should include a report detailing the results of a dam safety investigation.

3. Dam safety investigations as required herein shall be the responsibility of the applicant, be undertaken by a state-registered civil engineer, and shall include the following:

a. A thorough inspection of the dam for structural stability, assessing in particular the potential for earthquake-induced failure.

b. An identification of the likely characteristics of a potential dam failure, i.e., the area which must be evacuated, evacuation times, inundation profiles (flood depth), etc.

c. An identification of measures which will abate dam failure potentials and resulting hazards to human life and property.

CANAL AND LEVEE FAILURE

The Putah South Canal is a potential souce of earthquake-induced problems including possible flooding due to slumping, landslides, and liquefaction. And the old levee system which was built years ago to reclaim and protect much of the county's marshland is also a potential source of flooding. The levees are subject to damage due to slumping, liquefaction, peat oxidation, subsidence, and erosion.

Specific Policies

The following provisions respond to potentials for flood damage due to canal or levee failure:

1. All proposals for developments involving human occupancy which fall within potential inundation proximity of a levee or canal shall be accompanied by a report detailing the results of an inspection of the levee or canal by a state-registered civil engineer. The inspection shall focus on the following specifics:

a. Hazard potential determinants such as reliability of the facility during a 100-year flood event; rate of settlement (levees only), potential for slumping, and routine maintenance requirements under normal conditions; potential for failure due to seismic shaking (landsliding, slumping, liquefaction, etc.); likely inundation area, flood profile by location, and evacuation times in the event of failure; etc.

b. Any necessary levee or canal improvements that should be made to protect life and property in the proposed development against identified failure and flood risks.

2. Development in areas identified in site investigations as subject to potential canal or levee failure shall be prohibited unless necessary levee or canal improvements are made or special flood-related site and building design standards are met, such as minimum elevation requirements for finished floors of any structure for human occupancy, restriction of grade-level openings, waterproofing of walls and floors, etc.

3. In the event that significant canal-related flood risks are identified, the county and/or cities should request that the canal owner make the proper improvements to mitigate such hazards, particularly where they threaten existing urbanization. (If, for example, investigations of the Putah South Canal as required herein consistently result in flood hazard findings, a request should be made to the Bureau of Reclamation to make the proper improvements).

4. As those public roadways which are atop levees are routinely maintained and improved, the levees themselves should also be improved through repair or reconstruction.

FIRE HAZARDS

Significant portions of foothill and mountainous watershed areas of western Solano County are threatened with wildfire risk due to a dangerous combination of factors including dense build-ups of fire-prone vegetation, the wind funneling effect of steep topography, poor access for fire fighting equipment, lack of water service and adequate water pressure at fire-prone elevations, and seasonal atmospheric conditions (warm, dry falls and summers, and afternoon winds). Extreme wildfire risk areas as designated on Figure 3 are those lands where dense vegetation of severe burning potential prevails (chaparral and heavy woodland). High wildfire risk areas on Figure 3 are those lands where vegetation of high burning potential prevails (mixed woodland and grassland).

In addition to these two areas of wildfire risk, the Montezuma Hills, Benecia Hills, Potrero Hills, Cement Hills, and eastern English Hills are designated on Figure 3 as high grassfire risk areas. Grasslands, which have a high ignition potential, occur in these areas in combination with periodic high winds. Fire risk is significant here, although not as severe as the mountainous wildfire risk areas.

Specific Policies

Designated fire hazard areas shall comply with the following provisions:

FIGURE 3
FIRE HAZARD

EXTREME WILDFIRE RISK AREAS - Chaparral, dense woodland, steep slopes, poor access, winds

HIGH WILDFIRE RISK AREAS - Woodland-grassland, grassland, steep slopes, poor access, winds

HIGH GRASSFIRE RISK AREAS - Grassland, grazing, hilly, winds

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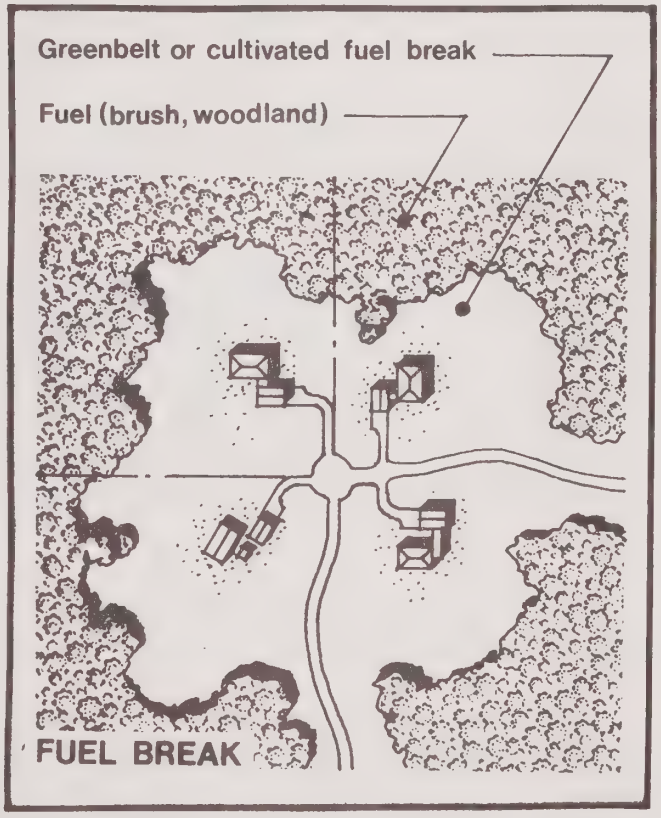
1. Residential development and road construction for public use shall be prohibited in areas of extreme wildfire risk.

2. Residential development shall be limited to a maximum of one dwelling unit per every five acres of land in areas of high wildfire risk. (Although the prevalent land use designation in these areas restricts development to 20 acre densities, certain subsections of these areas are designated in current plans for inappropriate densities and uses.)

3. The county and cities shall require grouping of residential units to provide for more localized and effective fire protection measures such as consolidation of fuel buildup abatement, fire break maintenance, fire fighting equipment access, and water service provision; and a more manageable localization or focus of any actual fire-fighting activity. (This would also serve to minimize extensive fuel buildup abatement which could be costly and inconsistent with open space and scenic protection policies of the general plan.)



4. In those designated wildfire risk areas where development already exists, the county and cities should undertake or continue any current land management programs to minimize fuel buildup around residences and other occupied structures. Such programs should include the establishment and maintenance of a greenbelt or cultivated fuel break between wildfire risk areas and urbanized areas. Brush, but not grass or woodland canopy should be periodically thinned out or cleared in this buffer zone to a width of at least 200 feet (brush provides an ignition interface between light ground fuels and heavy forest fuels). The dry, lower branches of mature trees in the buffer zone should be removed. Planting of non-resinous, fire-resistant plants and ground covers should be encouraged (these would also serve to control soil erosion).

5. In all designated wildfire risk areas, the county and cities should undertake or continue current programs to manage the interface between light ground fuels and heavy forest fuels so that easily started fires with low burning intensity can be controlled before

they have the opportunity to ignite dense chaparral and woodland areas. To accomplish this, the following measures should be taken:

a. Fire buffers should be created along heavily travelled roads by thinning, discing, or controlled burning (the latter is subject to E.P.A. restrictions). Brush, but not woodland canopy, should be cleared back from the road for 50 to 100 feet. The dry lower branches of mature trees should be removed.

b. Current firebreak programs should be continued throughout the interior of these wildfire risk areas where there are no roads. Brush removal for firebreak purposes shall be periodically maintained to a continuous minimum width of 200 feet.

6. In any land management programs for the purposes of fire hazard mitigation, an optimum balance shall be sought between the degree of fire-preventative thinning and clearing, and the retention of visual and natural resource values.

7. In addition to Uniform Building Code construction standards for fire protection, the county and cities should adopt building restrictions for residential development in designated wildfire and grassfire risk areas which prohibit the use of fire-prone exterior materials such as wood shingle or shake roofs.

8. In areas of high grassfire risk, the county and cities shall create fire buffers along heavily travelled roads by thinning, mowing, discing, or controlled burning of roadside grass.

NOISE

The principal source of noise in the planning area is vehicular traffic, followed in intensity and impact by local airport and railroad operations. Current and projected noise contours (the lines of intrusion by a given noise level in dBA) generated by freeways, highways, local arterials, airports and railroads in the planning area are mapped on Figures 4 through 9. These contours represent an average of all noise levels reached during a normal 24-hour day adjusted to an equivalent level which accounts for the greater intrusiveness of evening and nighttime noise. The adjusted noise levels are referred to as Community Noise Equivalent levels (CNEL).

Current and projected noise contours generated by aircraft activity at Travis Air Force Base are mapped according to twelve-year-old data provided by the Air Force. Significant revisions to that data are now being prepared by the Air Force. As soon as these are complete, copies will be provided by the Department of the Air Force Military Airlift Command Base Group at Travis to the county and participating cities. At that time, Figures 4 and 7 should be revised to show the more current noise contour data.

A definition of what constitutes noise, and an explanation of the impact of noise on human beings, the measurement and characteristics of noise, and specific noise conditions in this particular planning area, are provided under EXISTING CONDITIONS, pages 63 through 71.

To avoid annoyance and health problems associated with excessive community noise levels, the policies which follow serve to abate noise both at its impact point and at its source:

Specific Policies

Noise shall be controlled at its existing and projected impact or receptor points through the following policies:

1. Where a detailed noise analysis is required under certain provisions which follow, that analysis shall be the responsibility of the applicant, shall be prepared by a competent accoustical consultant[2] and shall include a representative set of on-site sound level measurements with appropriate spatial and temporal (day, evening, and night) variations, and a delineation of measured present and projected future noise contours ranging from 50 to 75 dBA, within the proposed development site. Where these sound measurements exceed maximum allowable levels, appropriate noise abatement measures shall also be identified in the analysis.

2. Any major land use proposal (major residential subdivisions and other uses for human occupancy) for lands within a designated noise level contour (Figures 4 through 9) shall comply with the land use policies indicated in Table 1. If Table 1 indicates that a detailed noise analysis is required, that analysis shall comply with provision #1 above. Proposed land uses shall be allowed only if the projected effect of proposed noise-abating design features are considered by the county or city to be sufficient to adequately reduce exterior and interior noise to acceptable levels. Interior noise level standards are listed in Table 2.

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2 A list of accredited noise consultants has been compiled by the California Department of Health, Office of Noise Control, 2151 Berkeley Way, Berkeley, California 94704; phone (415) 843-7900.

TABLE 1. LAND USE COMPATIBILITY CHART FOR EXTERIOR COMMUNITY NOISE

Exterior Noise Level Ranges (CNEL) and Related Land Use Policies (see legend, opposite page)

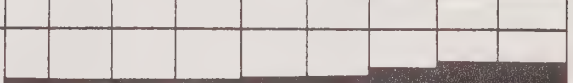
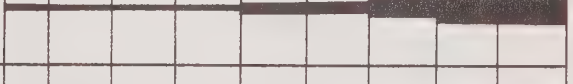
Land Use Category	Measured, Estimated, or Projected dBA 50 55 60 65 70 75 80 85 90
Residential. All dwellings incl. single-family, multi-family, group quarters, mobile homes, etc.	
Transient lodging. Hotels, motels	
School classrooms, libraries, churches	
Hospitals, convalescent homes, etc.	
Auditoriums, concert halls, amphitheaters, music shells	
Playgrounds, neighborhood parks	
Golf courses, riding stables, water-based recreation	
Office buildings. Personal business and professional services	
Commercial. Retail, movie theaters, restaurants	
Commercial. Wholesale, industrial, manufacturing, utilities, etc.	
Noise-sensitive manufacturing and communications	

TABLE 1 (continued)

Land Use Policies Legend

Acceptable land use. No special noise insulation requirements.

New construction or development allowed only after detailed noise analysis of construction requirements is made and needed noise-abatement features are included in design.

New construction or development should generally be avoided. If development does proceed, a detailed analysis of noise reduction requirements must be made and needed noise-abatement features included in design.

New construction or development generally not allowed.

SOURCE: Criteria developed with consideration of Federal Environmental Protection Agency findings on noise levels required for uninterrupted sleep or speech, from statistics on hearing loss in the population at large due to noise, from Highway Research Board findings (Highway Research Board, Highway Noise: A Design Guide for Highway Engineers, National Cooperative High Research Program Report 117, 1971), and from knowledge of planning area ambient noise levels.

TABLE 2. LAND USE COMPATIBILITY STANDARDS FOR INTERIOR NOISE IN dBA

Land Use	Maximum Allowable Interior CNEL
Residential	45
Transient lodging	45
School classrooms, libraries, churches	45
Hospitals, convalescent homes	45

Note: The acceptable interior noise level for other uses (offices, theaters, commercial, industrial) is dependent upon the specific nature of the indoor activity.

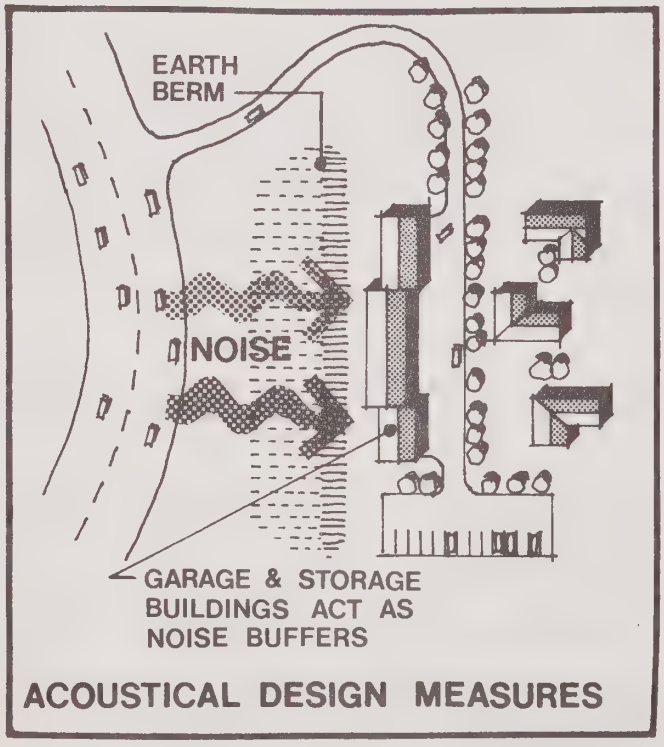
SOURCE: Same as Table 1

3. The county or cities shall establish a development review zone of 250 feet[3] along major freeways within which all development proposals which could be adversely affected by noise intrusion shall not be allowed until a detailed noise analysis is completed and noise abatement features are included in the development's design. Decreases in noise buffer depth may then be allowed based on county or city judgement regarding the projected effect on interior and exterior noise levels of proposed acoustical design features.

4. Where site conditions permit, noise buffers shall be required along local arterials and railroad alignments (Figures 4 through 9) for all new adjoining development which is subject to unacceptable noise levels as specified in Tables 1 and 2. The required buffer depth shall be based on a detailed noise analysis and on county or city judgement regarding the projected effectiveness of proposed noise-abating design measures.

5. New commercial land uses shall be allowed within designated major freeway, local arterial or railroad noise buffers only after a detailed noise analysis has been prepared and only if the development features an enclosed, interior orientation which, in the county or city's judgement, would adequately abate excessive exterior noise levels identified in the analysis.

6. Noise abatement design measures for new development in areas designated on Figures 4 through 9 as subject to noise intrusion might include the provision of earth berms or solid buffer walls (must be continuously sealed and of adequate height) providing that wall setbacks conform to Scenic Roadway Element policies; special building placement using the shielding effect of other buildings or the orientation of narrow, unfenestrated slides toward the noise source; continuous walls connecting structures which back on the noise source, acoustic building materials, insulation techniques, etc.



ACOUSTICAL DESIGN MEASURES

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3 The 250 foot width is based upon the noise-reduction effect of distance. Under average conditions (flat topography, no wind, etc.) a 10 dBA noise level reduction can be realized with each 100 feet of distance from the noise source.

7. For existing development for human occupancy which is incompatible with measured or projected noise contour levels, the county and cities should provide information to occupants and property owners on noise abatement measures that might be taken such as berming, installation of accoustical walls, soundproofing (double glazing, caulking, insulation), etc.

Noise shall be controlled at its source through the following policies:

1. The county and cities should place restrictions on trucking in residential and commercial areas, limiting delivery and loading times to daytime periods when ambient noise levels are highest.

2. The county and cities should establish specific truck routes where noise conflicts with land uses are least likely to occur.

3. The county and cities should maintain smooth street surfaces adjacent to land uses which are sensitive to noise intrusion. For example, grooved concrete pavement should be avoided.

4. The introduction of any fixed point, permanent, non-residential, noise-emitting land use (industrial, commercial, public utility, etc.) shall be prohibited if the projected noise emission level will exceed one or more of the following:

   a. 50 dBA CNEL as measured at the boundary of a nearby residential or agricultural zone.

   b. 60 dBA CNEL as measured at the boundary of a nearby commercial zone, business zone (personal services, offices), or noise-sensitive industrial or manufacturing zone (research, communications, etc.).

5. The county and cities should enforce the California State Vehicle Noise Standards for Motor Vehicles listed in Table 3, giving priority to areas where land uses are particularly sensitive to vehicular noise intrusion (residential areas, hospital and school zones, etc.). Local police are responsible for enforcing these noise standards on city thoroughfares. The California Highway Patrol is responsible for such enforcement on local freeways.

6. The county and cities should place restrictions on noise-emitting construction activities based on standards for construction equipment listed in Table 4. (These noise standards are relatively lenient since such activities are temporary and difficult to avoid, i.e., CNEL's as measured at the boundary of a construction site where these standards are enforced will still exceed acceptable standards for normal conditions.)

TABLE 3. CALIFORNIA STATE NOISE STANDARDS FOR MOTOR VEHICLES
(dBA at 50 feet from the center of the travel lane)

Vehicle Type	Less Than 35 mph	Greater Than 35 mph
Trucks	88	90
Motorcycles	82	86
Automobiles	76	82

SOURCE: California Vehicle Code noise emission standards for operation of licensed motor vehicles in California (Section 23130).

TABLE 4. MAXIMUM ALLOWABLE NOISE LEVELS FROM CONSTRUCTION EQUIPMENT

Equipment Type	Peak Noise Level in dBA at 50 feet
Earthmoving	
front loader	75
backhoes	75
dozers	75
tractors	75
scrapers	80
graders	75
truck	75
paver	80
Materials Handling	
concrete mixer	75
concrete pump	75
crane	75
derrick	75
Stationary	
pumps	75
generators	75
compressors	75
Impact	
pile drivers	95
jackhammers	75
rock drills	80
pneumatic tools	80
Other	
saws	75
vibrator	75

FIGURE 4

NOISE CONTOUR ESTIMATES - 1975
HIGHWAY, RAILROAD, AND AVIATION SOURCES

—40— COMMUNITY NOISE EQUIVALENT LEVEL (CNEL) CONTOURS, dBA

AREAS SUBJECTED TO NOISE LEVELS OF 65 dBA OR MORE

CNEL noise contours represent the average of all sound levels reached during a 24-hour day. Average figures are adjusted to an equivalent level which accounts for the greater annoyance of nighttime noise.

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SCALE IN FEET 0 5,000' 10,000'

FIGURE 5
NOISE CONTOUR ESTIMATES - 1975
LOCAL ARTERIALS - CITY OF FAIRFIELD

— 55 — COMMUNITY NOISE EQUIVALENT LEVEL (CNEL) CONTOURS, dBA

AREAS SUBJECTED TO NOISE LEVELS OF 65 dBA OR MORE

CNEL noise contours represent the average of all sound levels reached during a 24-hour day. Average figures are adjusted to an equivalent level which accounts for the greater annoyance of nighttime noise.

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SCALE IN FEET 0' 2000'

FIGURE 6
NOISE CONTOUR ESTIMATES - 1975
LOCAL ARTERIALS - CITY OF VACAVILLE

— 55 — COMMUNITY NOISE EQUIVALENT LEVEL (CNEL) CONTOURS, dBA

AREAS SUBJECTED TO NOISE LEVELS OF 65 dBA OR MORE

CNEL noise contours represent the average of all sound levels reached during a 24-hour day. Average figures are adjusted to an equivalent level which accounts for the greater annoyance of nighttime noise.

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SEDWAY/COOKE

0' 2000'
SCALE IN FEET

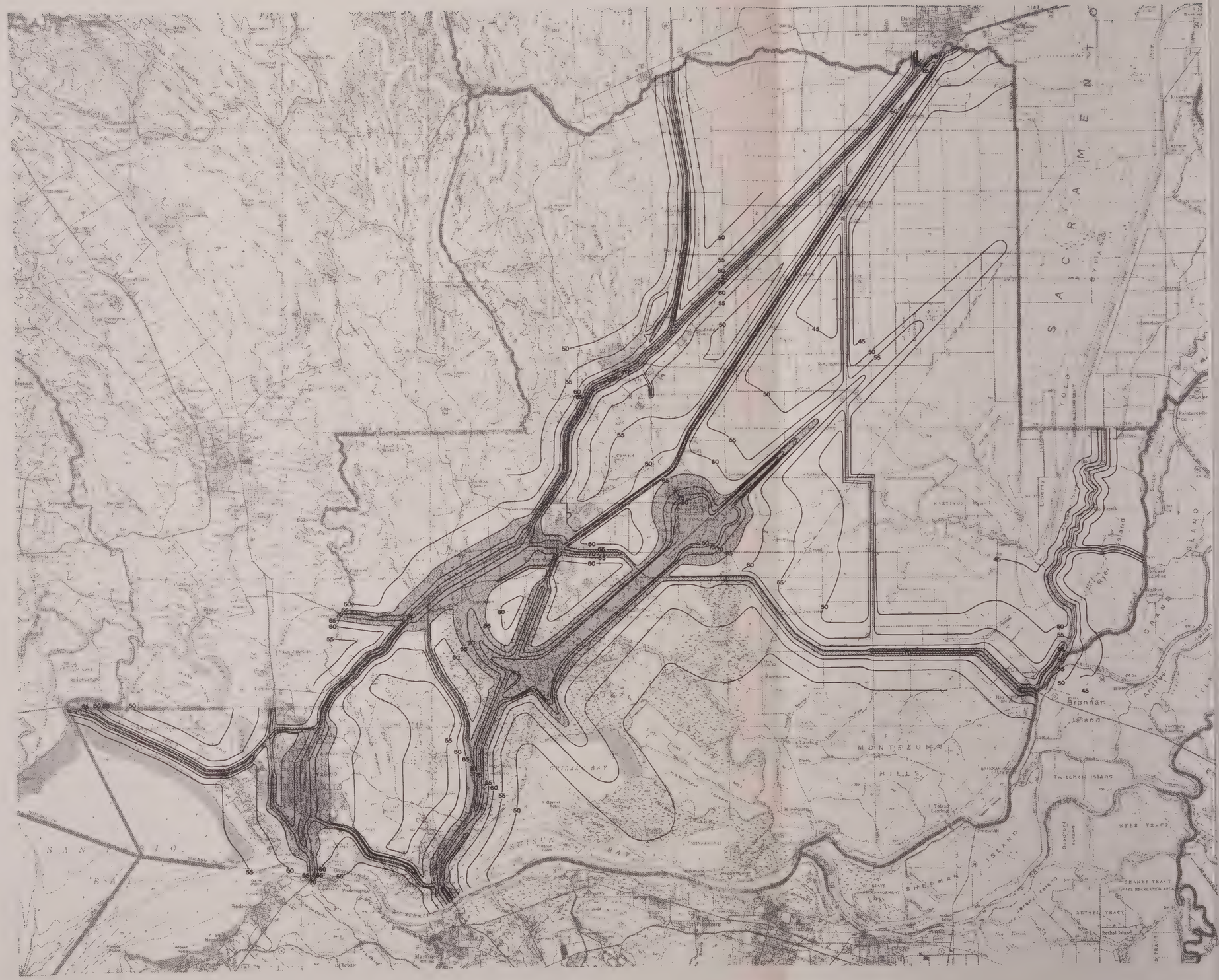
FIGURE 7

NOISE CONTOUR PROJECTIONS-1995
HIGHWAY, RAILROAD, AND AVIATION SOURCES

—60— COMMUNITY NOISE EQUIVALENT LEVEL (CNEL) CONTOURS, dBA

AREAS SUBJECTED TO NOISE LEVELS OF 65 dBA OR MORE

CNEL noise contours represent the average of all sound levels reached during a 24-hour day. Average figures are adjusted to an equivalent level which accounts for the greater annoyance of nighttime noise.



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SCALE IN FEET 0 5,000' 10,000'

FIGURE 8
NOISE CONTOUR PROJECTIONS-1995
LOCAL ARTERIALS-CITY OF FAIRFIELD

— 55 — COMMUNITY NOISE EQUIVALENT LEVEL (CNEL) CONTOURS, dBA

AREAS SUBJECTED TO NOISE LEVELS OF 65 dBA OR MORE

CNEL noise contours represent the average of all sound levels reached during a 24-hour day. Average figures are adjusted to an equivalent level which accounts for the greater annoyance of nighttime noise.

A CHAMBER OF COMMERCE
B CITY HALL
C COMMUNITY CENTER
D COUNCIL CHAMBER
E MECHANICS BUILDING
F POLICE DEPT.

1 DEL NORTE CT.
2 E. PACIFIC AVE
3 EL BASSET CT
4 EL CERRITO CT.
5 EL DORADO CT.
6 EL VERANO CT.
7 SAN MIGUEL DR
8 DEL PASO CT
9 DEL REY CT
10 DEL SUR CT

1 BARCELONA CIR
2 BARCELONA CT
3 GRANADA DR
4 ALCAZAR DR
5 RONDA DR
6 VALENCIA CT
7 VALERIO CT

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SCALE IN FEET 0' 2000'

FIGURE 9
NOISE CONTOUR PROJECTIONS-1995
LOCAL ARTERIALS-CITY OF VACAVILLE

— 55 — COMMUNITY NOISE EQUIVALENT LEVEL (CNEL) CONTOURS, dBA

AREAS SUBJECTED TO NOISE LEVELS OF 65 dBA OR MORE

CNEL noise contours represent the average of all sound levels reached during a 24-hour day. Average figures are adjusted to an equivalent level which accounts for the greater annoyance of nighttime noise.

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MISCELLANEOUS HAZARDS

Hazardous Cargoes

Although potentials for mishaps involving hazardous cargoes and land use adjacent to major transportation routes are real in Solano County (see EXISTING CONDITIONS, p. 57), the formulation of land use policies to specifically mitigate such risks becomes another issue concerning the level of acceptable risk. The realization of a completely hazard-free environment along major freeway and railway alignments would entail either a complete prohibition of hazardous cargo transport through the county, the provision in the design of a highway or railway of complete protection against the hazards of dangerous cargo mishaps, or similar provisions in the design of nearby land uses.

This degree of hazard abatement, i.e., the complete elimination of land use hazards associated with dangerous cargoes, would entail either total development prohibition or highly stringent and costly design requirements for all lands adjacent to local freeways and railways (very wide buffers between right-of-ways and development, diking stream enclosures, removal of existing roadside storm drains, etc.). In light of the very low frequency of hazardous cargo mishaps experienced throughout the county to date and likely to occur in the future, the adoption and implementation of such strict general plan provisions would be highly infeasible in terms of cost versus benefits, especially in areas which are already urbanized.

On the other hand, this safety element should and does recognize that the possibility of a transport mishap involving hazardous cargoes is present in the planning area. Certain provisions included in this general plan primarily in response to noise and visual issues will have the secondary effect of protecting land development near freeways and main railroad alignments from casualties or property damage due to mishaps involving hazardous cargoes. The plan provisions are those stipulating increased development setbacks and berming techniques for the purposes of noise and scenic buffering. Specifically, these provisions include the following:

In the Health and Safety Element under Noise, provisions 3 through 6 on page 22, and 7 and 2 on page 23.

In the Scenic Roadways Element, provision C3, page 15, and F1, page 17.

IMPLEMENTATION METHODS

GENERAL PLAN MODIFICATIONS

Where lands currently designated as "extensive agriculture" overlap areas identified in this element as highly unstable (Type A lands) or highly fire-prone (extreme wildfire risk areas), general plan modifications should be considered to discourage residential uses. "Extensive agriculture" provisions of the county and city general plan now allow residential development on 20 acre parcels.

Lands identified as Type A lands overlap with current intensive agriculture land use designations at the uppermost reaches of Pleasants Valley Road (west side), in the English Hills east of Putnam Peak, and along Twin Sisters Road in the vicinity of Suisun Reservoir.

Lands identified as extremely wildfire prone overlap with extensive agriculture land use designations throughout the Vaca Mountains, in the uppermost reaches of Green Valley, in Jameson Canyon, and in American Canyon on the south side of I-80.

There is currently no general plan language nor supporting zoning regulation, discouraging 20 acre residential development in these areas as a primary use. Current plans should be revised to stipulate that no new residential construction shall be allowed to overlap Type A and extreme wildfire risk lands unless it can be conclusively demonstrated to be auxiliary to an extensive agricultural use. In addition, the real agricultural value of these highly hazardous lands, particularly those of severe slope instability, should be reconsidered to determine whether an open space classification requiring larger parcel sizes in the range of 50 to 100 acres is more appropriate.

Other current general plan land policies should also be reconsidered by the county and cities where they may be in conflict with areas identified as extremely hazardous. For example, the following use designations may overlap areas identified herein as highly landslide prone Type A lands and therefore should be considered for conversion to a use which would not exceed the use limitations called for in this element (an exact determination of conformity is difficult due to the generality of the GP mapping):

a. "Suburban density" residential designations (2 d.u.'s/acre) north of Vacaville to Gibson Canyon Road and Browns Valley Road (Vacaville General Plan)

b. "Estate density" designations (1.5 d.u./acre) along the upper reaches of Rockville Road in Green Valley (Cordelia Area Specific Plan)

c. "Regional/highway commercial" designation southeast of the I-80/Suisun Valley Road intersection (Cordelia Area Specific Plan)

In addition, current general plan designations at the following locations may overlap areas identified in this element as extremely or highly wildfire prone:

a. "Suburban density" designations (2 du/acre) in the vicinity of Foothill Drive and Pleasants Valley Road overlap highly fireprone lands (specific policies in this element for high wildfire risk lands stipulate that densities shall not exceed 5 acres per dwelling unit).

b. "Low density" residential designations (2.5 d.u.'s/acre) along the west side of Suisun Valley Road at Rockville overlap extreme wildfire risk lands (specific policies herein stipulate that no residential development shall be allowed here)

c. "Intensive agriculture" designations(2.5, 5, and 10 acres/d.u.)overlap extremely wildfire prone lands along the upper reaches of Suisun Valley Road. This current general plan designation should be reconsidered in terms of the agricultural value of this land as compared to the risk potential. Perhaps a more extensive agricultural use allowing residential construction only as an auxiliary use would be more appropriate.

REGULATORY METHODS

As a primary means of implementing the specific land use policies set forth in this element, the county and cities should expand their regulatory programs to include the following specific ordinance and procedural requirements:

MANDATORY PLANNED UNIT DEVELOPMENT

Those planning area lands which are proposed for urban or suburban uses (five acres or less per occupied structure) and have been identified as subject to hazardous development constraints and in need of further site investigation and possible hazard abatement measures before safe development can be assured, cannot be adequately dealt with under normal zoning and subdivision procedures. At the present time, both county and participating city ordinances provide for P.U.D. procedures as an alternative to conventional provisions. Therefore, any subdivision or lot split submittal for urban or suburban purposes which includes lands identified in this element as in the Type B slope instability category, as subject to high wildfire risk, or as within noise contour bands (current or projected) exceeding 60 dBA, should be made subject to mandatory planned unit development procedures.

SPECIFIC PLAN PROVISIONS

The state-authorized specific plan technique provides the county and cities with an alternative regulatory measure to mandatory planned unit development. Specific area

planning can be employed to insure that proposed development layouts adequately consider hazards to safe development and natural resource values. The technique is particularly appropriate for larger development sites with a complex variety of natural and man-induced conditions and land use needs. Specific plans may include, but are not limited to mapped analyses of soil, geologic, seismic, flood, noise and visual conditions, and related controls on grading, building, building location, density, drainage, wildfire and flood protection, noise abatement, open space, circulation and access, landscaping and landscape preservation, public facilities, and natural resource protection. The specific plan is, in effect, a publically prepared and adopted planned unit development proposal. Such studies also provide an integrated and efficient means of environmental impact assessment. Specific plan preparation could be financed by groups of interested developers as part of the EIR process, or could be paid for through special assessment district procedures.

LAND CAPACITY ORDINANCE

For proposed developments of an urban or suburban nature, an effective means of relating allowable density to the specific characteristics of a site is through enactment of a land capacity ordinance. The purpose of such a regulation would be to ensure that the level of development permitted is based on the actual amount of buildable land and not on gross acreage. The ordinance would require documentation of a site's soil, geologic, seismic, hydrologic, slope, fire, and natural resource conditions and a determination, based on these factors of what portion of the site is safe and buildable. Additionally, other on- and off-site factors could be included in the calculations to determine allowable density and structure placement. The potential for natural disruption of roads, water and power lines, and emergency vehicle access would be a principal consideration in the density calculations.

NON-URBAN USE ZONES

The county zoning ordinance should be amended to include a new zone which places further restrictions on parcel size and residential use. Such a non-urban use zone could then be applied to lands including those now designated for extensive agriculture use which fall within Type A slope instability areas or extreme wildfire risk areas. Residential development would be prohibited in a non-urban use zone except as auxiliary to an agricultural or recreational use.

GRADING AND DRAINAGE ORDINANCE

The county and cities should enact a grading and drainage ordinance which would require special excavation precautions to minimize hazards in areas of slope instability, limit grading to those operations which would enhance ground stability without drastic site alteration, require special surface and subsurface drainage provisions, require that grading restore rather than disrupt natural patterns and volumes of surface runoff, and limit the construction of impermeable surfaces (structures, patios, roads, etc.) over naturally permeable soils and geologic areas.

SUBDIVISION ORDINANCE REVISIONS

County and city subdivision ordinances should be amended to incorporate specific data and design requirements related to surface faulting, ground failure, flooding, and noise.

FIRE ABATEMENT ORDINANCE

In order to minimize fuel buildups in fire-prone areas where occupied development exists, an ordinance should be enacted by the county and cities which would require private owners of such property in areas subject to wildfire and grassfire risk to periodically thin vegetation, clear underbrush, and maintain on-site fuel breaks.

CREEKSIDE ORDINANCE

The county and cities should enact a creekside ordinance for application to creek shoreland areas. The ordinance would override underlying zoning so as to protect both upstream and downstream shoreline and backshore areas from environmental and property damage resulting from creek encroachment by new development. Regulations should be provided to mitigate downstream flooding, avoid any upstream flood hazards, prevent hazards due to seismic induced lurching, provide access for channel maintenance, and protect natural riparian habitats. The ordinance should establish a shoreline zone of perhaps 25 feet parallel to the creek and a backshore zone of perhaps 150 feet upslope from the boundary of the shoreline zone. Provisions can then be formulated which set the uses permitted in each overlay zone as well as specific standards and criteria for development within the zones.

BUILDING CODE AMENDMENTS

In addition to the latest edition of the Uniform Building Code, the county and cities should enact additional building standards including special foundation requirements and further grading restrictions for lands identified as unstable, special measures to resist seismic loadings, added foundation requirements for liquefiable and expansive soils, special limitations on exterior building materials in wildfire risk areas, specific flood-proofing measures for construction in flood-prone areas, and accoustical design measures for noise-sensitive structures.

NOISE REGULATIONS

Implementation of noise abatement policies requires two types of regulatory responses. The first response should consist of adding noise performance standards to existing zoning provisions. It is recommended that general provisions be added to the zoning ordinances establishing three levels of permitted noise emission by stationary sources. The most permissive level would permit 75 dBA CNEL at the property line and would be applied pri-

marily to heavy manufacturing zones. The next would allow up to 60 dBA CNEL at the property line and would be applicable for most office, general retail and light manufacturing zones. The most restrictive provisions would limit emission to a level not greater than 50 dBA CNEL at the property line. These latter provisions would apply primarily to residential areas but could also be applied in other special circumstances such as to areas adjoining hospitals and schools. Additionally, general provisions should be added to the zoning ordinance which would prohibit any uses from emitting noise which, as measured at the property line of any lot in an adjoining or nearby zone with more restrictive noise requirements, would exceed the standard set for the adjoining or nearby zone (see Table 1). These noise standards would be administered as a part of the regular zoning and building permit application process. The applicant would be responsible for ensuring compliance with the standards.

The second type of response should be enactment of a noise ordinance which would regulate mobile or short duration types of noise emissions or noise generated by added equipment which does not require zoning approval or a building permit. Types of problems covered by such provisions include on-site vehicular operations such as truck loading and unloading, operation of construction equipment and amplified music. Enforcement of such noise abatement provisions would generally be done on a complaint basis.

EIR PROCESS

Coordinating Environmental Impact Assessment, Subdivision or P.U.D. Map Submission, and Land Capacity Ordinance Procedures

The state-mandated EIR process can be used as a means of coordinating and integrating various development review procedures into an internally consistent regulatory process organized for efficient use and administration. Such a coordinated development review process offers advantages both to developers and to local planning staffs. The following EIR process is recommended:

1. Data requirements which are necessary in preparing the "existing environment" portion of an EIR shall be met through the subdivision or P.U.D. ordinances as described in this section which should require the applicant to provide specific data requirements pertaining to natural resource values including vegetative and animal habitats, hydrology, slope conditions, and scenic resources; hazards including slope instability, seismicity, flooding, fire, and noise; and public service and facility needs generated by the proposed development (on-or off-site roads and utilities related to or potentially affected by proposed development, schools, police, fire, park, and recreation facilities).

2. The above data on natural resources and hazards shall also provide the applicant with the basis for applying land capacity ordinance provisions to determine the permitted level of development. This determination should be reviewed by county or city staff before the applicant proceeds with preparation of his tentative map.

3. After the above data has been gathered and an allowable level of development has been determined, the applicant shall then submit his tentative maps to the county or city. The maps must be accompanied by documentation of the development alternative(s) considered and an explanation of why the submitted scheme has been selected. The submission must include documentation of the impacts associated with each alternative. (This requirement should be sufficient to meet EIR requirements for considering project alternatives.)

4. The county and city staff or an EIR consultant selected by the county or city shall review the applicant's tentative map submittal and shall determine (a) if the environmental analysis is adequate; (b) if reasonable alternatives have been considered, i.e. those which would eliminate or minimize identified adverse impacts; and (c) if the documentation of impacts is complete. In the event that any of the above are incomplete, the county or city would authorize either the applicant or EIR consultant to undertake any necessary additional work. If the EIR is found adequate, or following any additional work required to meet EIR requirements, the staff or consultant will prepare the draft EIR incorporating any plan modifications, design changes, or other conditions considered necessary to mitigate adverse impacts.

5. The required hearing for the tentative subdivision or P.U.D. map would be held jointly with the E.I.R. hearing and the application approved subject to whatever conditions are considered essential.

6. The final map would be submitted for staff review to determine compliance with adopted provisions. Final approval could then be granted.

Coordination of the General Plan and the EIR Process

The General Plan provisions of this section have identified specific EIR assessment requirements which must be met in various parts of the County. Briefly these include:

a. Detailed site analysis requirements of development proposals including Type B lands (soils, geologic, and seismic data).

b. Detailed site analysis requirements for major development proposals falling within one quarter mile of a fault (fault location and activity data, hazard mitigation measures).

c. Site investigation requirements for all projects proposed for areas identified as underlain by liquefiable soils.

d. Dam safety investigation requirements for development proposals which fall within the potential inundation area of a levee or canal.

e. Detailed noise analysis requirements for development proposals within certain noise level contour areas.

GOVERNMENTAL PROCEDURES

A series of additional governmental methods that the county and participating cities can consider as a means of implementing the policies outlined in this element are briefly described below:

SPECIAL ASSESSMENT DISTRICTS

The county and cities should assign their legal council the task of establishing more precisely the authority for use of special assessment procedures for following planning and landslide damage contingency purposes:

Special Planning District

Special assessment district procedures might be applied by the counties and cities to finance specific planning area activities. Where the specific area plan process is considered to be an appropriate technique for a particularly large and complex site, the site could be temporarily designated as a special assessment district for (a) the specific purpose of funding the planning effort or (b) the purpose of funding public improvements and any related planning efforts. The latter may be a more legitimate basis under present law for forming a special assessment district primarily to fund a specific area planning effort.

Special Landslide Prevention and Maintenance District

For the purpose of relieving the community-at-large from the burden of maintenance and repair costs due to landslide damage to public facilities in an area of Type B lands (subject to slope instability problems), present legislation might enable the county to require the formation of a special maintenance district as a condition of a major development approval. Although no provisions for the formation of special districts specifically for landslide-related maintenance purposes currently exist, such use of special assessment procedures may be allowable under county service area, community services district, or other special district provisions related to maintenance of public roads and utilities.

With the requirement for the formation of a special landslide assessment district as a condition of major development approvals on Type B lands, assessments could then be made on the development itself (property owners) if and when landslide damage to public facilities occurs, or to finance preventative measures.

JOINT DATA COLLECTION PROGRAM

The county and cities should jointly initiate a geologic and seismic data collection program

to accumulate data relevant to development review and planning purposes. Any data collected on faults in proximity to developing areas could then be mutually shared. A duplicate file should be established in each of the participating planning departments. Reference to the file should be required as part of normal development review procedures. Where file data becomes sufficiently detailed and adequate, certain investigation requirements in regard to a particular site could be waived.

JOINT SEISMIC SURVEYS

The county and cities should individually or jointly investigate the possibility of contracting with the State Division of Mines and Geology, or the U.S. Geological Survey, for special studies to determine seismic activity and associated hazards of active and possibly active faults that traverse the planning area.

JOINT CONSULTANT ASSISTANCE PROGRAMS

The county and cities could execute a joint contract on a part-time basis with private consultants to achieve needed capabilities for expert review of required soil, geologic, seismic, dam, and noise investigations; or the county and cities could establish a joint staff position to aid both the county and cities. Costs of such consulting services as they relate to a particular development proposal should be incurred by the applicant.

COUNTY FLOOD CONTROL DISTRICT

The County Flood District should be expanded to assume a leadership and coordinating role to realize an integrated areawide flood control program. Such a program could ensure that flood control is approached on an integrated upland-lowland, watershed basis. The County Flood Control District is the appropriate body to coordinate all county and municipal public works flood control efforts as well as inter-county efforts which involve the same watersheds.

EXISTING CONDITIONS

In previous pages, a set of specific plan policies and related implementation techniques is provided that responds to certain seismic, geologic, hydrologic, fire, and noise conditions which act as development constraints within the planning area. In this section, these conditions are defined and located in greater detail and an explanation of how each acts as a constraint to safe land development is provided.

SEISMIC AND GEOLOGIC HAZARDS

SLOPE INSTABILITY

Landslides, land slips, mudflows, and debris flows have been the subject of numerous studies in the San Francisco Bay region. In this geologically young area, continued uplift of the Coast Range Mountains has resulted in widespread susceptibility to mass movement, particularly in upland areas. The use of aerial photos to map landslides has shown that these mountainous areas are frequently covered by massive landslides a mile or more in length. The age of these giant landslide features is not well known, but some of them probably originated during a period of greater rainfall several thousand years ago. Despite their age, these large landslides are generally quite unstable, and can be reactivated by grading operations or other development activities.

Landslide susceptibility is a function of various combinations of factors including rainfall, rock and soil types, steepness of slope, slope orientation, vegetation, seismic conditions, and works of man. Currently, the U.S. Geological Survey is preparing a slope instability map based on the fact that landslides occur most often on slopes steeper than 15 percent, in areas with a history of landsliding and in areas underlain by certain geologic units. This work (as yet unpublished) has been used in preparing Figure 10, a relative slope instability map for Solano County. The USGS map divides the area into six slope stability categories ranging from generally stable, to highly susceptible to slope failure. The three most hazardous categories are shown on Figure 10. A brief description of all six categories is presented here, along with the distribution of each category throughout the planning area.

Category 1: Areas of 0-5 percent slope which are not underlain by known landslide deposits or other deposits known to be unstable at low slope angles. Although generally stable, locally steep slopes (such as along water courses) may be susceptible to slope failures. Category 1 consists primarily of the floodplain area between the Montezuma Hills and Putah Creek.

Category 2: Areas of 5-15 percent slope that are not underlain by landslide deposits or other deposits highly susceptible to slope failure on moderate slopes. Category 2 lands are found throughout the western half of the planning area, but especially in the Vallejo/Benicia area and east of the English Hills.

Category 3: Areas of greater than 15 percent slope which are not underlain by landslide deposits or other bedrock units that are susceptible to landsliding. This category is generally stable, but may include small unmapped landslides or small areas of unstable bedrock. Most of the Vaca Mountains (including Cement Hill) are in Category 3. Other areas in this category are between Suisun and Green Valleys, and northwest of the English Hills.

Category 4: Areas of greater than 15 percent slope that are underlain by bedrock units which are highly susceptible to landsliding, but are not underlain by landslide deposits. The English Hills, the highlands between Vallejo and Benicia, the Potrero Hills and hills northwest of Fairfield all have large areas of Category 4 land.

Category 5: Areas of 0-90 degree slope which are underlain by or immediately adjacent to landslide deposits. These areas include many types of terrain, but most commonly are fairly steep hillsides underlain by bedrock which is highly susceptible to landsliding. This category also includes some small or narrow (less than 1000 feet wide) areas not underlain by landslides. Category 5 lands exist mainly in the mountains west of Green Valley from Columbus Parkway and Lake Herman Road to Wild Horse Creek. Another area dominated by landslide deposits is east of Twin Sisters and west of Suisun Valley. These two areas contain many very large landslides, and represent the greatest concentration of landslides in the county. Other hillsides are not free of this problem, however, and slope failures have been mapped in both the English Hills and the Vaca Mountains (including Cement Hill).

Slope instability results in the loss of millions of dollars annually in the nine Bay Area counties. Taylor and Brabb (1972), in a U.S.G.S. study, showed that over $25 million was lost because of landslide damage in the Bay Area during the winter of 1968-69. Although this cost is somewhat higher than the annual average because of unusually high rainfall, similar amounts of rainfall can be expected to fall at least once a decade, and these may cause widespread landsliding. The planning area has had a history of relatively low dollar loss from landsliding due to the lack of large-scale development intrusion into hillside areas, a situation which is subject to future change as indicated in Figure 11, Hazards Associated with Current Land Use Policy.

Landslide damage varies according to the type of slope failure which occurs. When private homes are involved in landsliding, they often become total losses to their owners since resale value is greatly reduced by demonstrated conditions. Mudflows may do only minor structural damage, but because of their rapid movement, they are

FIGURE 10
SLOPE INSTABILITY CATEGORIES

SYMBOL	CATEGORY	CHARACTERISTICS
	1,2	GENERALLY STABLE LANDS - Slopes of zero to 15 percent underlain by stable deposits
	3	- Slopes of 15 percent or greater underlain by stable deposits
	4	UNSTABLE LANDS - Slopes of 15 percent or greater underlain by landslide prone deposits
	5	HIGHLY UNSTABLE LANDS - Slopes of zero to 90 percent underlain by existing landslide deposits

GENERAL PLAN REVISION PROGRAM
COUNTY OF SOLANO · CITY OF FAIRFIELD
CITY OF VACAVILLE · CITY OF SUISUN CITY

SEDWAY/COOKE

SCALE IN FEET 0 5,000' 10,000'

capable of trapping or burying people, and seriously damaging landscaping, building interiors and parked automobiles. Even when structures themselves are sited on stable bedrock, landsliding and small land slips can present problems for access roads and utility maintenance. Slope failures can also cause blockage of water courses and resulting flood damage during months of high flow.

Seismic conditions can intensify slope instability problems, particularly if shaking occurs when the ground is wet. Even moderate earthquakes can cause slope failures. For example, a Magnitude 5.3 earthquake that occurred in San Francisco in March of 1957 triggered a number of slides along the coast, blocking State Highway 1. The maximum intensity of this earthquake was only VII on the Modified Mercalli Scale (see Appendix A). Within the planning area, the hills near the active Green Valley fault are especially prone to seismically induced landsliding due to their proximity to a potential epicentral area. This proximity to an active fault may be partly responsible for the very large number of landslide deposits that exist there at the present time.

SURFACE FAULTING

Geologic evidence indicates that the planning area is laced with a number of faults, i. e., fractures or fracture zones in the earth's crust along which there has been displacement of the two sides relative to one another parallel to the fracture. The displacement may be a few inches to several feet. Cumulative displacement through geologic time may reach miles.

If any surface displacement in excess of an inch or two along one of these faults were to occur beneath a building, transportation facility, main utility line, aqueduct, etc., the effects could be catastrophic. Therefore, it is important to know the relative likelihood of future movement along these faults and to plan accordingly.

Known planning area fault traces are shown on Figure 1. Some are considered active, i.e., capable of displacement in the near future. Others, although not recognized as active, must be considered as potentially active until they are investigated more closely.

Active Faults

An active fault is one along which historic movement has been documented. Active faults are recognized by the following criteria:

1. Historic fault movement

2. Displacement of Holocene deposits (soil or rock materials less than 10,000 years old)

3. Evidence of fault creep -- slow ground displacement without accompanying seismic events

4. Seismic activity along fault plane

5. Displaced survey lines

6. Geomorphic evidence -- e.g., offset stream courses, sag ponds, scarps, fault troughs and fault saddles

At present, segments of only two planning area faults are known to be active: the Green Valley fault and Concord fault (see Figure 1). The trace of the Concord fault trends northwestward through the City of Concord into Solano County, just northeast of Benicia. It has been studied in detail by Robert Sharp (1973) who documented right lateral creep along the fault trace. In 1955, an earthquake of Magnitude 5.4 occurred on the Concord fault, causing population centers in the planning area to experience intensities of V-VI (maximum intensity at the epicenter was VII). This was sufficient to break windows and glassware and crack plaster. (See Appendix A, p.77, for a detailed description of Modified Mercalli Scale.)

The Green Valley fault has been the focus of recent studies by the State Division of Mines and Geology (Dooley, 1972) and is currently being investigated by the U.S. Geological Survey. This fault trends northwestward along the eastern front of the Benicia Hills and appears to have right lateral offset (Dooley, 1972), which means that the western side has moved northward relative to the eastern side, or vice versa. The fault shows many features associated with recent activity including offset fences and power lines, location of microearthquake epicenters along the fault trace, scarps in Holocene alluvium, disrupted drainage patterns, and a conspicuous alignment of topographic depressions and saddles.

The Green Valley fault has also been investigated by a number of consultants in connection with development projects in Green Valley. These investigations have included trenching and geophysical surveys, and have provided additional evidence of recent activity. Although the fault can be traced from Suisun Bay northward across the county line, definitive evidence of activity is lacking north of where it crosses Green Valley Creek. The heavy vegetative cover in this area makes both aerial photographic and field studies difficult. Both the Concord fault and the Green Valley fault (south of the Green Valley Creek crossing) have been designated as active faults by the State, and have been included in Special Studies Zones under the Alquist-Priolo Geologic Hazards Zones Act (Chapter 7.5, Division of Public Resources Code). The zone of actual rupture on a fault is generally small compared to the area which is subjected to severe ground shaking. Displacement along the Green Valley fault could be as much as $2\frac{1}{2}$ feet for an earthquake of Magnitude 6+. It is possible to greatly reduce damage due to such fault rupture by avoiding construction on active fault traces.

Areas of special concern associated with these potentials for surface faulting and major transportation and transmission routes in the study area are mapped on Figure 12. Fault rupture along the Green Valley fault can be expected to cause damage to Interstate 80, State Highways 12 and 21, and the Southern Pacific Railroad line through Cordelia. Freeway overcrossings may be displaced or may collapse as a result of fault movement. Designated county evacuation routes to the south, Highways 80 and 21, should not be relied upon as post-earthquake routes since they are subject to blockage by earthquake-induced damage or collapse.

A number of water, gas, and oil pipelines cross active segments of the Green Valley fault within the planning area and could create flooding, fire, and pollution problems if earthquake-induced rupture were to occur. There are several ways, however, to reduce the hazard of pipeline rupture. Smaller fault displacements can be accommodated by expansion joints or flexible piping at fault crossings. New oil, and water mains are often provided with this or similar features when laid across a known active fault. Natural gas, oil, and water pipelines are often equipped with pressure-operated shutoff or block valves that stop transmission when there is free flow somewhere in the line.

The Southern Pacific Pipeline Co. (Main Office, Los Angeles) has two pipelines that cross the Green Valley fault, paralleling the S.P. Railroad alignment from Suisun City to Benicia. These are both petroleum pipelines, one seven and one ten years old. The block valves nearest to the Green Valley fault crossing are at Benicia to the south and Suisun City to the north. No automatic valving is used on these lines.

Pacific Gas Transmission Company operates three major gas transmission lines which cross the Green Valley fault. A ten inch line to Marin and a 16 inch line to Sonoma have been laid westward from Cordelia through Jameson Canyon. A third pipeline brings gas to Vallejo from the two other lines in Cordelia. Block valves at the company's Cordelia Regulation Station can shut off flow to all lines crossing the fault. Valves on the other side of the fault are located two miles west of Cordelia, in Jameson Canyon, and about six miles south of Cordelia.

Although some of these pipelines also cross the Suisun Marsh, no special precautions have been taken to avoid rupture there due to liquefaction or ground shaking. PGT engineers reportedly have had no problems with their pipelines through soft soils other than a tendency for them to rise to the surface. The flexible nature of the steel piping apparently prevents leaking and they are simply reburied.

The alignment of the Green Valley fault with the Concord fault strongly suggests that they are strands of the same fault. If the two faults are considered together, then the magnitude of earthquake which might be expected from the fault system will be greater than that from either one alone. Therefore, these faults are listed both separately and as a single fault in Table 5, which lists all known active faults near Solano County and

the potential for damage in the county. The location of these faults is shown in a regional context on Figure 13.

Faults of Unknown Activity

Although other faults in the county are not considered active, it should not be assumed that all of them are inactive. Often faults are not recognized as active until the urbanization process allows them to be looked at more closely. For example, the accurate determination of microearthquake epicenters requires a sufficient network of seismograph stations around the area of interest. But such networks are usually installed in high-priority areas where earthquake research is important; i.e., in urban areas of high seismicity. Within the last two or three years the National Center of Earthquake Research (a branch of the U.S. Geological Survey) expanded their detection network to include most of southern Solano County. When current investigations are published, the pattern of microseismic activity within the county may suggest other faults that could be active.

Leighton and Associates (1975) has considered the Franklin and Southhampton faults to be potentially active because their trend and sense of movement suggest that they may be part of the Calaveras fault system. They have recommended more detailed study of these and several smaller faults in the Vallejo area. Within the planning area there are several other faults that could possibly be active, such as the Vaca Valley fault, the Kirby Hills fault, and the Lagoon Valley fault. The Midland fault is a fault whose activity is also unknown. It was discovered by oil and gas explorations in the eastern part of the county. It represents a displacement of rocks 3000-4000 feet below the surface, but has no known surface expression. If this fault were to prove active and an earthquake were to occur on it, surface rupture would be unlikely, but considerable damage from ground shaking could be expected.

SEISMIC SHAKING

Earthquake-generated ground shaking is by far the greatest single cause of earthquake damage. Solano County has had a history of earthquake shaking which goes back more than 150 years. Important historic earthquakes are tabulated in Tables 6 and 7 which follow.

TABLE 5. ESTIMATED POTENTIALS FOR STUDY AREA EFFECTS FROM REGIONAL SEISMIC ACTIVITY

Fault Source	Fault Location	Historic Earthquakes	Max. Probable Richter Magnitude	Est. Intensity in Solano Co. (firm ground)	Probable Effects in Solano County
San Andreas fault	38 miles SE of Fairfield	Great San Francisco earthquake Mag.=8.3	8+	VI-VII	Frightens everyone. Heavy furniture moves or overturns. Some glass breakage. Slight damage to modern buildings on firm ground. Heavy damage to masonry structures on poor ground. Local ground failure in marshy or river bank areas.
Hayward-Healdsburg-Rogers Creek fault system	24 miles SE of Fairfield	1836 and 1868 Hayward earthquakes Mag.=7±	7+	VI-VII	Similar to effects of San Andreas earthquake.
Green Valley fault	Fault passes through Green Valley in western part of county, 8 mi. west Fairfield	Microearthquake activity only	6+	VIII-IX near (within a mile or two of)Green Valley fault. VII in SW part of county including Fairfield. V-VI elsewhere.	Moderate to severe damage to existing or new structures in SW part of county. Landsliding and liquefaction in SW part of county. Moderate damage elsewhere in county.
Calaveras-Concord fault system	14+ miles south of Fairfield	1961, on Calaveras, Mag. 6-7 1955, Concord, Mag. 5+	6+-7+	VI Possibly VII in delta area.	Similar to effects of San Andreas or Hayward quakes.
Unidentified fault(s) in eastern half of county	East of Vaca mountains (?)	1892 Mag. 6-7+	7+	VIII-IX	Moderate to severe damage in central part of county with ground failures on hillsides, along creek banks or in marshy areas. Water may be thrown out of canals and streams.

TABLE 6. STRONG EARTHQUAKES (ESTIMATED MAGNITUDE EQUAL TO OR GREATER THAN 6 3/4) WHICH HAVE ORIGINATED NEAR SOLANO COUNTY

Date		Epicentral Area (Earthquake Fault)	Maximum Intensity (MM)* In Epicentral Area
June 9-10	1836	East San Francisco Bay (Hayward fault)	IX-X
June -	1838	San Francisco/San Mateo Co. (San Andreas fault)	IX-X
Oct. 8	1865	Santa Cruz Mountains (San Andreas fault)	IX
Oct. 21	1868	East San Francisco Bay (Hayward fault)	X
April 19	1892	Vacaville (unknown fault)	IX
April 21	1892	Winters (unknown fault)	IX
April 18	1906	San Francisco (San Andreas fault)	XI

See Appendix A, page 77, for an explanation of the Modified Mercalli (MM) Intensity Scale

TABLE 7. OTHER STRONG EARTHQUAKES (MAXIMUM INTENSITY EQUAL TO OR GREATER THAN VII ON MODIFIED MERCALLI SCALE) WHICH HAVE ORIGINATED WITHIN 50 MILES OF SOLANO COUNTY

Date	Epicentral Area (Earthquake Fault)	Maximum Intensity (MM)* In Epicentral Area
June 21, 1808	San Francisco	VII (?)
Feb. 15, 1856	San Francisco	VII
Nov. 26, 1858	San Jose	VIII
July 3, 1861	Amador Valley (near Livermore)	VIII
May 19, 1889	Collinsville/Antioch	VII
July 31, 1889	San Francisco Bay	VII
Oct. 11, 1891	Napa/Sonoma	VII-VIII
Mar. 30, 1898	Mare Island	VII
May 19, 1902	Elmira/Vacaville	VI-VII
June 11, 1903	Niles	VII
Aug. 2, 1903	San Jose	VII
Oct. 23, 1955	Concord	VII
Oct. 1, 1969	Santa Rosa	VII-VIII

See Appendix A, page 75, for an explanation of the Modified Mercalli (MM) Intensity Scale.

It is clear from Tables 5,6, and 7 that Solano County is in an area of relatively high seismicity and will be subject to earthquake shaking in the future. No part of the planning area will be free from the effects of seismic shaking. Earthquake-triggered landslides, addressed earlier, are a potential major problem which can be induced by only moderate shaking. Ground failure in the form of soil liquefaction, lurching, and settlement, could also result from shaking (addressed under GROUND FAILURE). Flood damage from earthquake-induced dam failure, canal and levee damage, and tsunami are also seismic shaking-related threats to existing and future urbanization (see FLOODING).

Depending upon the magnitude, proximity to epicenter, and subsurface conditions (bedrock stability and the type and thickness of underlying soils) present at a given point beneath the surface of the planning area, shaking damage which can be expected to occur in the next few decades will vary from slight to intensive. For example, the wet unconsolidated soils of the Suisun Marsh would have a high ground response, while areas of hard rock generally would experience lower intensities of shaking, but would be subject to other earthquake-induced hazards such as landsliding. The peat and organic soils of the delta would experience large scale amplification of seismic waves. Structures located in these areas would be subject to severe shaking during an earthquake.

Different types of structures are subject to different levels of ground-shaking damage. Conventional one and two story wood-frame residential structures generally have performed very well during strong earthquake ground shaking. Collapse or total destruction of wood-frame homes is rare, even during strong earthquakes, except in cases where these structures are affected by ground rupturing or landsliding, or are affected by extremely high ground acceleration. For example, several famous photographs taken after the great 1906 earthquake show wood-frame homes standing intact and apparently undisturbed just a few feet away from the main scar of ground rupturing along the San Andreas fault line.

Studies of more recent earthquakes show that the following types of structural damage from earthquake shaking can be expected to occur to some modern wood-frame homes of the type found in Solano County:

1. Possible shifting of homes on foundations. This problem has been minimized in recent years by requirements that adequate structural connection between house frame and foundation be provided.

2. Damage to masonry chimneys or facades. Damage or toppling of unreinforced brick walls or chimneys commonly occurs in strong ground shaking. Code-required reinforcement and chimney ties can help minimize damage, but will not prevent it completely.

3. Falling of unbraced water heaters, with possible fire hazard.

4. Cosmetic damage, especially cracking of plaster, and some glass breakage.

Damage to unconventional "custom" type houses is often more severe in earthquakes.

Not surprisingly, the damage ratio, expressed as a percentage loss of value to the "average" residential area due to an earthquake, becomes higher with increasing intensity of ground shaking. Studies with estimates applicable to typical Bay Area conditions suggest that the damage ratio associated with various intensities of shaking would be approximately as follows:

Intensity	Damage Ratio, %
V	0.1
VI	0.5
VII	2.5
VIII	8.3
IX	12.1

Thus, a rough estimate of the levels of housing damage expected in the planning area in a great earthquake, with intensity values of VIII-IX, would be on the order of 10 percent of the value of all housing.

Commercial and industrial buildings are more difficult to classify than tract housing because of the variety of building types found in the planning area. In the older areas, one and two story wood frame and stucco structures could be expected to show fair performance in earthquakes. Old unreinforced masonry buildings, however, particularly those constructed prior to 1933 (when improved building codes were adopted in California), are not resistant to earthquake shaking and may be severely damaged during strong shaking. The fall of decorative masonry parapets and cornices sometimes found on such buildings has been a major cause of injuries during previous quakes.

A small number of pre-1933 masonry buildings in the planning area may present public safety hazards during seismic shaking, since they were constructed prior to seismic-related revisions to the building code. An intensity value of VIII - IX on the Modified Mercalli Scale will probably cause partial or total collapse of at least one or two of these structures. Two-story masonry buildings are particularly susceptible to major damage and collapse during an earthquake. Such two-story buildings are present in central Vacaville on the south side of Main Street, in central Suisun City on the west side of Main Street, and less significantly (one example), in central Fairfield on the north side of Texas Street (see Figure 1).

With regard to newer buildings, single story wood-frame or tilt-up construction has generally sustained only moderate damage during earthquake shaking, although recent experience in San Fernando suggests that minimum code requirements with respect to roof-to-wall connections in tilt-up buildings may not be adequate to assure public safety, especially in high-occupancy commercial buildings. Hence, roof or wall collapse must be considered a possibility in at least a minority of tilt-up buildings during VIII-IX intensity shaking. During a strong earthquake, the damage and safety of tilt-up buildings in industrial areas would depend to some degree on the special structural design precautions and care in supervision of construction which had been provided to these buildings. This, of course, would depend mainly on the owner of the building, the county or city's responsibility being limited to a general plan check and spot inspection aimed at assuring conformance with minimum code requirements only.

Freeway and railroad interchanges in Solano County will be very susceptible to collapse as a result of earthquake ground shaking. The San Fernando earthquake of 1971 (Magnitude 6.6) resulted in the total or partial collapse of five interchange structures and damage to a number of others. Total structural damage to highways and bridges was estimated at $9.5 million.

Lurch cracking is another phenomenon that occurs during earthquake ground shaking, and involves the horizontal movement of soil masses toward the open face of creek banks. Creekside homes are especially vulnerable to damage from lurch cracking.

Despite these generalizations, the extent to which a specific structure is damaged is a function of the design and construction quality of the particular building and the local soil conditions. The specific characteristics of shaking which can be expected at a given site and the reaction of a certain type of structure to such shaking must be determined on an individual basis by site investigation.

GROUND FAILURE

LIQUEFACTION

Soil liquefaction results from loss of strength during earthquake shaking. The most susceptible soils are clean, uniformly graded, loose, saturated, fine grained sands. The granular soil material is transformed by earthquake shaking into a fluidlike state in which solid materials are virtually in suspension, similar to quicksand.

The liquefaction of soils can cause them to move laterally outward from under buildings, roads, pipelines, transmission towers, railroad tracks, and other structures such as bridges. Damage is usually greatest to large or heavy structures on shallow foundations, and takes the form of cracking, tilting, and differential settlement. Where gentle slopes exist, such as on stream or slough banks, liquefaction may cause lateral spreading landslides. Whole buildings can be moved downslope by this type of ground failure. Where the condition is known to exist, proper structural and foundation design can usually minimize or eliminate liquefaction hazard to new construction.

Soil layers with high liquefaction potential are also present in the existing and former marsh areas of the county which are underlain by saturated bay mud. Furthermore, liquefaction potential in Solano County has increased in recent years because of a rising water table in many parts of the planning area. Portions of the planning area subject to liquefaction are shown on Figure 1. Areas of special concern associated with liquefaction potential and current land use policies and major utility alignments are mapped on Figures 11 and 12, respectively.

Prior to 1958, the primary source of agricultural water was from local wells drilled into the Tehama Formation, an extensive aquifer in the central and eastern parts of the county. However, by 1959, surface water from Putah South Canal was available at low agricultural rates, and many irrigation wells were abandoned. The cessation of pumping in agricultural areas has resulted in a dramatic ground water rise since 1959. Where these water conditions are combined with loose, fine grained sands, i.e., prime agricultural soils, liquefaction potential is high.

SUBSIDENCE

Other soils that present a development hazard are the subsidence-prone peat soils of the Suisun Marsh and the Napa River delta west of Vallejo which were drained in the early 1900's by the development of a levee system. When exposed to the air, these soils tend to oxidize. Oxidation lowers the elevation of these exposed areas by as much as .3 feet per year. The highly organic soils on Ryer Island and along Lindsay and Cache Sloughs are also subject to settlement and subsidence.

The question of subsidence due to gas withdrawal from the numerous natural gas fields scattered across the planning area is often raised, but if there is some subsidence attributable only to gas withdrawal, it is probably of minor significance in comparison to the degree of subsidence caused in gas field areas by peat oxidation. No concrete information on subsidence due to gas extraction within the county has been located.

SETTLEMENT AND SHRINK-SWELL POTENTIAL

Perhaps 20 to 30 percent of the planning area's flat land is underlain by soil having a high settlement or shrink-swell potential. Expansive or shrink-swell soils are those that contain significant amounts of clay minerals that swell when wet and shrink when dry. These clays tend to swell despite the heavy loads imposed by large structures. Damage (such as cracking of foundations) results from differential movement and from repetition of the shrink-swell cycle. In some cases, this problem may be avoided by removing the top soil layer before placing a foundation.

Soils having high shrink-swell potential in at least the top 12 inches are found throughout the county, especially in the eastern one-third, and are often referred to as "adobe" soils. Travis Air Force Base and the cities of Fairfield and Rio Vista are also largely underlain by expansive soil deposits. Although these soils can be an expensive nuisance, awareness of their existence prior to construction often means that the problem can be eliminated through proper foundation design. Appendix B is a short information sheet which can be distributed to building permit applicants to acquaint them with the problem.

Where appreciable thicknesses of bay mud underlie the extensive existing and former marsh areas of the county, sinking and differential settlement can occur leading to damage of structures sited on these lands. Damage due to such settlement can be overcome to a large degree by proper site preparation and foundation design. In general, however, development in these bay mud areas would probably involve fills and would have a high potential for building and road damage due to differential settlement. Failure of poorly constructed fills, or seismic liquefaction of the sand layers within the mud that the fills rest on, could result in substantial damage to roads and structures founded upon these fills.

FLOOD HAZARD

STORMWATER AND TIDAL INUNDATION

By far the major portion of flood-prone lands in the planning area, as shown on Figure 2, are subject to inundation due to heavy rainfall and resulting stream overflow. A number of streams in the planning area have long histories of seasonal flooding, often resulting in significant damage. Such floods can occur anytime during the rainfall months from November 1 through May 1. Flood risk is intensified in the lower stream reaches by the likelihood of coincident high tides and strong offshore winds during periods of heavy rainfall.

While floods of the recent past have been frequent and have caused significant damage to homes, businesses, crops, roads, etc.; they have not approached the disastrous results that can be expected with a relatively rare 100-year storm. The estimated inundation areas for such a 100-year flood event are also shown in Figure 2.

The potential for flood damage in the planning area is further aggravated by spreading urbanization which is having the combined effect of encroaching upon and reducing flood plain area in the low-lying areas while increasing the rates and volumes of runoff by overlaying higher lands (structures, paving, etc.), thereby restricting natural infiltration.

Fairfield-Suisun Area Conditions

Five streams which periodically overflow in the Fairfield-Suisun area are Ledgewood, Pennsylvania Avenue, Union Avenue, Laurel, and McCoy creeks. In the lower reaches of this creek system, flood hazards are intensified by high tides and resulting drainage restrictions. As a result, lowland floodwater ponding frequently does not drain for several days.

Floods have occurred in the Fairfield-Suisun area in 1950, 1955, 1958, 1966, 1967, 1970 and 1973. These floods have resulted in substantial losses to residences, businesses, drops, roads, etc. Furthermore, aforementioned investigations indicate that more severe meteorological conditions than those that have caused floods in the recent past could occur in the future, resulting in even greater flood damage. Accordingly, Figure 2 delineates the probable inundation area of a 100-year flood event.

Drainage improvements to provide additional protection for existing and future Fairfield-Suisun urbanization against the effects of seasonal flooding have been proposed by the U.S. Army Corps of Engineers in their "Fairfield Vicinity Streams" flood control project, scheduled for completion in 1977. The project would include a combination of channel improvements, diversion channels, drop structures, and the utilization of two existing detention basins.

In addition to the U.S. Army Corps of Engineers' proposed project, the City of Fairfield Department of Public Works has proposed a number of drainage improvements within the developed portions of the existing urban center, and where new development areas are designated in northern and western Fairfield.

Cordelia-Rockville Area Conditions

The potential for flood damage is also high in the vicinity of Cordelia and Rockville along the Green Valley, Dan Wilson, and Suisun creeks. These streams have a long history of flooding, particularly along the lower reaches of the Green Valley Creek

which are influenced by Suisun Bay tides. The most severe flood conditions occur there when heavy rainfall coincides with high tides and offshore winds.

Floods have occurred in the Cordelia-Rockville area eleven times since 1937, or once every three to four years on an average. The largest and most damaging flood occurred in 1955 and was estimated to be a 40-year event. As mentioned earlier, investigations indicate that larger flood-producing storms should be expected in the future. The extent of inundation that can be expected to occur in the Cordelia-Rockville area from a 100-year flood is indicated on Figure 2.

Knowledge of the high flood potential and likely inundation areas around Cordelia and Rockville is particularly critical due to current land use pressures and policies in that area. Although development here is currently sparse, the area is expected to become one of the county's principal growth areas in the near future.

Major flood control and drainage systems have been proposed for the Cordelia-Rockville area in the "Water-Sewage-Drainage Element" of the Central Solano County General Plan (1974) as a guide for the future preparation of an engineering master plan for the area. The element recommends flood plain zoning, creek rechannelization, the construction of one or more retention basins, and special land treatments in the upper reaches of stream watersheds to minimize erosion and excessive runoff.

Vacaville Area Conditions

The Vacaville area is subject to frequent flooding from a number of creeks including Alamo and Ulatis creeks, the two major local watercourses; Encinosa and Laguna creeks which drain from the west into Alamo Creek; and Horse Creek and its several tributaries which drain the area east of the English Hills and ultimately flow to Ulatis Creek downstream from Interstate 80. Both Alamo and Ulatis Creeks drain the Vaca Mountains where rainfall intensity is relatively high, and flatten abruptly in the flat agricultural areas just above Pleasant Valley Road, often overspilling their banks and inundating lands north of town.

Floods have occurred in the vicinity of these Vacaville streams eleven times since the 1930's. The most severe and damaging floods took place in 1967 and 1973. And like other flood-prone areas in the county, these floods were not as extensive and potentially damaging as a flood generated by a 100-year storm would be.

Vacaville areas where flood risk is currently greatest are: (1) the North Orchard-Crestview area between Vaca Valley Road and the existing limits of development north of Hemlock School where development is now taking place, and (2) the Southeast Assessment District area in northern Vacaville, east of the English Hills, which is feeling pressures for development after recent sewer and water system installations.

The City of Vacaville in its Drainage Plan for Vaca Valley and Browns Valley Water Sheds (1974) proposes improvements to alleviate local drainage problems in these areas, but does not address major flooding problems relating to creek overflow.

All of the Vacaville area streams remain in their natural state as they flow through town. Downstream from I-80, channel improvements have been constructed which have helped to alleviate the flood problem in that area to some extent.

TSUNAMI AND SEICHE

Tsunamis are long-period ocean waves commonly caused by vertical faulting of the ocean floor. Such earthquake-associated waves (often erroneously called tidal waves) can cause considerable damage when they reach shallow coastal areas. Although Japan, Alaska, Hawaii, and California have all experienced damaging tsunamis during historic times, such waves do not reach the California coast very often. Ritter and Dupre in their 1972 U.S.G.S. Field Study (MF-480), estimate that the frequency interval of a tsunami with a 20 foot run-up at the Golden Gate is about once every 200 years. (The amount of run-up is the vertical height above still water level that the rush of water reaches.) A 30 foot wave might be expected once every 500 years. However, a study made in 1960 and 1964 indicates that a tsunami entering San Francisco Bay would be reduced in height by 50 percent as it passes Point San Pedro and by 90 percent before reaching the Carquinez Strait. The only areas of the county that would be subject to inundation by tsunamis, as shown on Figure 2, are the southwestern part of Mare Island and Island No. 1 southwest of Highway 37. The possibility of a tsunami being generated in San Pablo Bay (by the Hayward fault, for example) was also considered. But the shallowness of the Bay, and the predominant strike-slip motion of the active faults crossing the Bay, indicate that such an event is unlikely. Even if it were to occur, the resulting wave would not be high enough to inundate large areas.

A seiche is a stationary wave produced in reservoirs, lakes, and other closed or restricted bodies of water by ground shaking. The phenomenon is similar to the oscillations which result when a bowl of water is shaken. When they occur in large reservoirs, such waves can cause overtopping of dams, posing a serious threat to urbanized areas below. Areas subject to inundation due to such overtopping are, of course, the same areas as those shown in Figure 2 as subject to dam failure inundation.

DAM FAILURE

Senate Bill 896 (Government Code Section 8499.5), passed March, 1973, requires that the State of California Office of Emergency Services (O.E.S.) identify all dams in the state whose failure would cause injury or loss of life and prepare maps indicating the

inundation area assuming failure. Dam failure characteristics -- the potential rapidity and degree of failure and inundation -- are based on the structural type of each dam (earth, multiple arch, etc.).

The O.E.S. has identified ten such dams in Solano County as listed in Table 8. Inundation maps for the following nine county dams have been prepared and are summarized in Figure 2.

TABLE 8. PLANNING AREA DAMS (See Figure 2)

Name of Dam	Structural Type	Capacity (acre-feet)	Owner	Date of Construction
1. Fleming Hill No.2	Earth	34	City of Vallejo	1912
2. Lake Chabot	Earth	1120	City of Vallejo	1870
3. Lake Frey	Earth	1075	City of Vallejo	1894
4. Lake Herman	Earth	2210	City of Benicia	1905
5. Lake Madigan	Earth	1711	City of Vallejo	1908
6. Pennsylvania Creek	Earth	160	State Div.of Highways	1958
7. Pine Lake	Earth	360	City of Benicia	1942
8. Summit Reservoir	Earth	221	City of Vallejo	1968
9. Swanzy Lake	Earth	107	City of Vallejo	1931

An inundation map for the following county dam has not yet been submitted:

10. Putah Creek Diversion	Gravity	720	U.S. Bureau of Reclamation	1957

Dams located inside the planning area, but declared exempt from the O.E.S. inundation mapping program since no injury or loss of human life is anticipated with failure, are listed below:

11. Bascherini Dam	Earth	19	Solano Irrigation Dist.

TABLE 8 (CONTINUED)

Name of Dam	Structural Type	Capacity (acre-feet)	Owner	Date of Construction
12. Dickson Hill Dam	Earth	23	City of Fairfield	
13. Giles Dam	Earth	119	Billy Yarbrough	
14. Green Valley Lake Dam	Earth	150	J.J. Willard	
15. Harris Dam	Earth	40	William J. McGuire	
16. Maine Prairie Dam #3	-	96	Maine Prairie Water District	
17. Mangels Dam	Earth	276	Lewis Mangels	
18. Municipal Dam	Earth	169	City of Suisun	
Dams located outside the county area which, with failure, would inundate planning area lands are:				
19. Lake Curry	Earth	10,700	City of Vallejo	1926
20. Monticello Dam (Lake Berryessa)	Concrete Arch	1,600,000	U.S. Bureau of Reclamation	1957

Four of the dams listed above -- Lakes Chabot, Frey, Herman, and Madigan -- are relatively old and, if failure were to occur, could endanger population centers in the planning area. The county and cities affected may wish to obtain more detailed information on the stability of these dams from their owners.

Inundation maps for Monticello Dam at Lake Berryessa have not yet been submitted. However, since this dam retains one of the largest reservoirs in northern California storing 1,600,000 acre-feet of Putah Creek water, it is likely that extensive flooding of planning area lands would occur if this dam were to fail. Monticello Dam was constructed relatively recently (1957) and is considered to be seismically sound.

CANAL AND LEVEE FAILURE

Putah South Canal Conditions

The Putah South Canal is a potential source of earthquake-generated problems, including possible flood damage due to slumping, landslides and liquefaction (see Figure 12). Between Abernathy Road and Jepson Road there has been a problem with slumping and landsliding into the canal from the hillside areas to the north. Although in the past this has been primarily a maintenance problem, if a large landslide (perhaps triggered by earthquake shaking) were to block or rupture the canal during a period of high flow (i. e., summer), flooding would occur before repairs could be made. The Solano Irrigation District (S.I.D.) has already experienced one incident of total blockage and is aware of the potential problem. Although S.I.D. personnel were able to clear the canal within 24 hours, the blockage occurred during a period of relatively low flow, and so was not as severe as it might have been at high flow.

Another Putah South Canal situation that concerns the Solano Irrigation District is the flooding potential south of Vacaville, where Alamo Creek intersects the canal. During periods of high flow, Alamo Creek often overflows into the canal. On at least one occasion, very high water in Alamo Creek damaged the canal and deposited a large amount of sediment in it. This situation clearly has implications for new development in the southeast Vacaville area.

Another potential seismic hazard occurs where the canal crosses soils that have a locally high liquefaction potential. The three areas where this might be a problem are where the canal crosses Ledgewood Creek on Suisun Valley Road, the Laurel Creek crossing north of Fairfield, and between Ulatis and Alamo Creeks, east of Vacaville. Although it is not certain that liquefiable soils exist at these sites, high water table conditions favoring liquefaction are present in Suisun Valley and east of Vacaville.

Channelized Sections of Alamo Creek

Alamo Creek, where it has been channelized east of Nut Tree Road, is a potential source of flood problems during periods of heavy runoff. Increased urbanization in tributary areas of Alamo Creek and resulting increases in volumes and rates of surface stormwater runoff may result in damaging overflows in areas west of Nut Tree Road which are currently designated for residential densities of from five to seven units per acre.

Levee Conditions

The old levee system which exists in the marshlands of the planning area was constructed initially by hand labor and later by dredging to hold back river floods and daily tides, and hence, to obtain additional lands for grazing and crop growing. Today, these levees remain as embankments five to six feet high with foundation widths of roughly 20 to 30 feet. Roads have been constructed atop a number of levees. Levees are constructed with weak materials excavated from adjacent water courses, i.e., sands, silts, and peat.

Constant maintenance is necessary to hold these levees against the high tides and river floods that threaten reclaimed marsh lands. New material must be added to these levees continually to compensate for peat oxidation. Sand, silt, and peat are weak in shear and erode easily. And each year, as farm lands adjacent to the levees subside (see GROUND FAILURE), hydrostatic pressure against the levees increases, adding to the potential for failure. The fact that most of these levees are not maintained to any specific standards increases the likelihood of failure and inundation.

The potential failure of levees due to liquefaction constitutes a potential hazard in much of the southern half of Solano County. Some enclosed areas are several feet below sea level at present and are subsiding at a rate of up to three inches per year. Most of these diked areas are in agricultural use and some are so far below sea level that it would be economically infeasible to drain them should they be flooded as a result of levee failure. Failure of levees south of Suisun City could flood parts of that city, causing damage to housing.

Roads in the Suisun Marsh and in the east county are constructed almost exclusively on levees; levee failures could seriously disrupt travel through these areas. Although these roads primarily serve local farmers, there is increasing recreational traffic which would also be affected.

FIRE HAZARD

Significant portions of the foothill and mountainous watershed areas of west Solano County are threatened with wildfire (see Figure 3) due to a combination of factors including dense buildups of fire-prone vegetation, the wind-funneling effect of steep topography, poor road access for fire fighting equipment, lack of water service and adequate water pressure at fire-prone elevations, and seasonal atmospheric conditions (warm, dry, falls and summers, and afternoon winds). In addition to these areas of wildfire risk, the Montezuma Hills, Benecia Hills, Potrero Hills, Cement Hills, and eastern English Hills are indicated on Figure 3 as an area of high grass fire risk. These areas consist predominantly of rolling grassland, extensive agriculture grazing lands and other dry farming operations. Fire risk is significant here, although grassland fires are not as potentially intensive as mountainous brush fires, and these hills are relatively accessible by fire-fighting equipment. Furthermore, the likelihood of serious conflagration in the Montezuma Hills has been reduced by fire-preventative measures taken regularly by a number of farmers which include controlled burning, discing and plowing. Such practices are particularly common along roadways where ignition potentials are high.

The likelihood of wildfire ignition in foothill and mountainous areas is increasing with pressures for further development of foothill subdivisions north and west of Vacaville, west of Fairfield, in northern Green Valley, at Cordelia, and on the opposite side of the Vaca Mountains in Napa County. Furthermore, many of these wildfire hazard factors, including poor road access, inadequate water supply and pressure, and ignition potential, are exacerbated by the likelihood of future earthquakes.

Before nearby lowlands were urbanized, the dominant plant species in these west foothill and mountainous communities were naturally maintained by periodic fire. But as nearby lands were developed, natural wildfires were suppressed resulting in the further buildup of highly fire-prone brush and woodland assemblages.

Figure 3 conveys two aspects of wildfire hazard: the ignition potential of high-use areas (roads, urbanization) and the burning potential of various vegetative types. For example, grassland adjacent to a heavily traveled road has a high ignition potential because of the high probability and ease with which grass will ignite. A dense woodland canopy, on the other hand, has a low ignition potential with its heavier fuels, but burns with a much higher intensity and ultimately has a worse effect on the ecosystem. The mountainous chaparral assemblages (especially chamise) of west Solano County are notorious for their explosive character and rapid rate of spread. The worst fire hazard occurs where easily ignitable grass is growing with brush which in turn serves as an extremely effective fuel link to the dense woodland canopy.

Areas of extreme wildfire risk as designated on Figure 3 are those mountainous and hilly areas of high ignition potential near fuels with extremely high burning potential, i.e., chaparral (chamise, manzanita, scrub oak, and sage) and dense woodland (live oak, laurel, and madrone). Areas of high wildfire risk on Figure 3 are those with high ignition potential near fuels with high burning potential, i.e., woodland-grass (tree clusters with intervening ground areas occupied by herbaceous growth) and grasslands (principally herbaceous growth).

Water Supply.

Unincorporated Areas of Solano County. Due to the unimproved, rural character of most unincorporated lands in Solano County, fire districts serving these areas are equipped with mobile water supplies, i.e., tank trucks. In addition, land uses in these areas from agricultural intensive (A-5) on up are required to maintain 4000 gallons of water storage or enough water to provide flows of 200 gallons per minute for 20 minutes.

Fairfield. The City of Fairfield recently completed a major water supply expansion program which includes a new 15 MGD water treatment plant and a 10 MG reservoir. These facilities, in addition to the city's previous capacities of 16 MGD treatment and 13.8 MG storage, are adequate to easily provide for significant increases in the maximum daily consumption rate (13 MGD for 1974) plus fire-fighting needs.

Suisun. City of Suisun fire officials consider the water supply in Suisun City to be adequate to support their fire-fighting needs. Beyond its normal water supply (deep wells and the Solano County Irrigation District), the city is developed along the Suisun Slough. Each Suisun City fire truck is equipped with a 2000-foot hose to tap slough waters as necessary for fire-fighting purposes.

Vacaville. Daily flows reached an unprecedented 10 MGD peak during a summer, 1975 hot spell, exceeding maximum daily pumping capacities (9½ MGD) and posing serious fire protection problems. Since that period, however, two new wells have been added to Vacaville's existing supply and will be "on line" by the summer of 1976, bringing peak capacity up to 12½ MGD, an adequate increase for short-term fire protection purposes. Furthermore, the city is budgeting towards implementation of a newly adopted master plan which will include the construction of one additional reservoir and the rebuilding of two wells to accommodate future growth projections and fire protection needs.

MISCELLANEOUS HAZARDS

Agricultural Spraying

A number of herbicides and insecticides which are classified by the State Department of Food and Agriculture (DFA) as potentially injurious to humans are used in Solano County for weed control in the Montezuma Hills and elsewhere, and for pest control in the extensive vineyard, orchard, and row crop lands of the county. Although hazards from injurious pesticides are experienced predominately in occupational situations (handling), some hazards to neighboring land use may occur in application stages.

If crop spraying activities occurred on croplands adjacent to a non-agricultural, human-occupied use, on a windy day, for example, drift could constitute a hazard to the neighboring use. For this reason, state law stipulates that such sprays shall not be applied within one mile of a residential area. This provision is enforced by the local agricultural commissioner through a permit issuance procedure. Use of any of a list of hundreds of insecticides and herbicides which are classified as "injurious" by the DFA, is prohibited without issuance of such a permit.

Hazardous Cargoes

Although considerations for land use hazards associated with the transport of hazardous cargoes are not specifically required by state planning legislation (see Government Code Section 05302.1), such hazards do exist in Solano County due to the fact that a number of major, interstate transportation routes pass through the area and a wide range of hazardous cargoes are regularly transported along these routes.

Types of hazardous cargoes regularly transported out of, into, and through Solano County by freeway or railroad include flammable liquids, corrosive materials, compressed and/or poisonous gases, explosives, flammable solids, irritating materials,

radioactive materials, etc. The transportation of such cargo in the county creates obvious hazards for existing and proposed land uses adjacent to those transportation routes.

Some potential exists, for example, for spillage of a flammable liquid due to a highway or railway mishap, subsequent ignition of the liberated contents due to its inherently low "flash point," and possible human casualty and property damage occuring in the path of the burning liquid. Burning spillage can also drain into nearby streams and drainage facilities (roadside storm drains, etc.) spreading fire and increasing the area of drainage. Such mishaps have, in fact, occurred in Solano County's recent past.

AREAS OF SPECIAL CONCERN

The county and cities should set priorities for the implementation of the policies enumerated in this general plan element on the basis of where current development pressures and any evident conflicts between land use practices and existing conditions are occurring, and of the relative severity of hazard associated with such conflicts.

Figures 11 and 12 map locations where current land use policies and practices seem to conflict with the development suitability of various planning area lands. These "areas of special concern" have been identified by overlaying Figures 1, 2 and 3 with maps of current land use policy and major utility alignments. Figures 11 and 12 are keyed to the two lists which follow. For the purpose of establishing planning priorities, identified areas of special concern are grouped below in three hazard classifications - very high, high, and moderate:

AREAS OF SPECIAL CONCERN
Hazards Associated with Current Land Use Policy

Note: Numbers below correspond to designations in grey on Figure 11.

Very High

1. Estate, medium and high density residential, three school sites, and industrial designations, all atop bay mud

2. Estate density residential designation and school site within area of high slope instability (Type A lands) and overlapping area of extreme wildfire risk

3. Mixtures of residential, commercial, and industrial designations within "special studies zone" of Green Valley fault (active), and overlapping areas of extreme and high wildfire risk

High

4. Estate density residential designation within area of highly unstable slopes (Type A lands) and overlapping a high wildfire risk area

5. Low density residential designation within area of highly unstable slopes (Type A lands)

6. Same as 5

7. California Medical Facility atop Kirby Hills fault trace (activity unknown)

8. Medium density residential designation within area of unstable slopes (Type B lands)

9. Estate density residential designations atop bay mud

10. Estate density residential designation atop fault of unknown activity

11. Industrial designation atop bay mud

Moderate

12. Low density residential designation atop northern fork of Midland fault trace (activity unknown)

13. Industrial designation atop northern fork of Midland fault trace

14. Industrial designations atop southern fork of Midland fault trace

15. Low density residential designation atop fault trace of unknown activity

16. Low and medium density residential atop Kirby Hills fault trace (activity unknown)

17. Low density residential designations atop Kirby Hills Fault trace

18. Commercial designation atop fault trace of unknown activity

19. Industrial designation atop Kirby Hills fault trace

20. Same as 19.

21. Estate density residential designation atop fault of unknown activity

FIGURE 11
HAZARDS ASSOCIATED WITH CURRENT LAND USE POLICY

AREA OF SPECIAL CONCERN-
Evident conflict between hazards and current land use designations
(Numbers keyed to descriptions on pages 58-60)

CURRENT LAND USE POLICY

RESIDENTIAL	D.U.'S/ACRE
Estate Density	.2 - 1
Low Density	2 - 9
Medium Density	10 - 19
High Density	20+
SCHOOL SITE	
COMMERCIAL	
INDUSTRIAL	
RECREATIONAL	
AGRICULTURAL - INTENSIVE Prime Lands - Specialty Crops	
AGRICULTURAL - EXTENSIVE Grazing and Watershed Lands	

GENERAL PLAN REVISION PROGRAM
COUNTY OF SOLANO · CITY OF FAIRFIELD
CITY OF VACAVILLE · CITY OF SUISUN CITY

SEDWAY/COOKE

SCALE IN FEET 0 5,000' 10,000'

AREAS OF SPECIAL CONCERN
Hazards Associated with Major Utility Alignments

Note: Numbers below correspond to designations in grey on Figure 12.

Very High

1. Intersection of water main and Green Valley fault trace (active)

2. Convergence of Interstate 80, natural gas pipelines, electric transmission lines, existing and proposed water mains, Putah South Canal, and the Southern Pacific Railroad, passing through "special studies zone" (Alquist-Priolo Geologic Hazards Zone Act) of Green Valley fault trace (active)

3. Southern Pacific Transportation Co. right-of-way (railroad tracks and petroleum pipeline) atop bay mud and crossing "special studies zone" of Green Valley fault trace (active)

4. Intersection of Southern Pacific Transportation Co. right-of-way and "special studies zone" of Concord fault trace (active)

High

5. Potentially liquefiable prime agricultural soils underlie major transportation and transmission alignments.

6. Same as 5

7. Same as 5

8. Intersection of Interstate 80 and Lagoon Valley fault (activity unknown)

9. Northernmost extension of slumping and landslide problems experienced along Putah South Canal (#18 = southernmost extension)

10. Interstate 80 passing through area of highly unstable slopes

11. Intersection of water main and Gordon Valley fault trace (activity unknown)

12. Intersection of Putah South Canal and Kirby Hills fault trace (activity unknown)

13. Intersection of railroad tracks, petroleum line, electric transmission line, and proposed water main alignment with Kirby Hills fault

14. Intersection of Putah South Canal and fault of unknown activity

15. Putah South Canal passes through area of highly unstable slopes

16. Intersection of Putah South Canal and Lagoon Valley fault

17. Same as 11

18. Southernmost extension of slumping and landslide problems experienced along Putah South Canal (#9 = northernmost extension)

19. Putah South Canal passing through highly unstable slopes and across fault trace of unknown activity

20. Intersection of Interstate 80 and fault trace of unknown activity

21. Natural gas pipeline passing through area of highly unstable slopes

22. Southern Pacific Railroad tracks and electrical transmission lines atop extensive bay mud

23. Electrical transmission line atop bay mud

24. Southern Pacific Railroad and electrical transmission lines atop bay mud

25. Southern Pacific Transportation Co. right-of-way (railroad tracks and petroleum pipeline) atop bay mud

26. Interstate 80 passing through areas of high slope instability

27. Intersection of natural gas pipeline and fault trace of unknown activity

28. Intersection of Interstate 80 and fault of unknown activity

29. Intersection of Interstate 80 and natural gas pipeline with fault traces of unknown activity

30. Intersection of petroleum and natural gas pipelines with Kirby Hills fault trace

31. Petroleum line and natural gas pipeline atop bay mud

Moderate

32. Intersection of natural gas line and northern fork of Midland fault trace (activity unknown)

33. Intersection of Temporary Interstate 505 and southern fork of Midland fault trace (activity unknown)

FIGURE 12
HAZARDS ASSOCIATED WITH MAJOR UTILITY ALIGNMENTS

22 — AREA OF SPECIAL CONCERN- Evident conflict between hazards and major utility alignments (Numbers keyed to descriptions on pages 61-63)

ALIGNMENTS

- EXISTING GAS MAINS
- ELECTRIC TRANSMISSION LINES
- PETROLEUM PIPE LINES
- EXISTING WATER MAINS
- PROPOSED WATER MAINS
- PUTAH SOUTH CANAL
- MAJOR HIGHWAYS
- SOUTHERN PACIFIC RAILROAD

GENERAL PLAN REVISION PROGRAM
COUNTY OF SOLANO · CITY OF FAIRFIELD
CITY OF VACAVILLE · CITY OF SUISUN CITY

SEDWAY/COOKE

SCALE IN FEET 0 5,000' 10,000'

34. Intersection of Interstate 80 and northern fork of Midland fault trace

35. Intersection of Southern Pacific Transportation Co. right-of-way (railroad tracks and petroleum line) and northern fork of Midland fault trace

36. Intersection of Interstate 80 and southern fork of Midland fault trace

37. Intersection of State Route 113 and northern fork of Midland fault trace

38. Intersection of Southern Pacific Transportation Co. right-of-way (railroad tracks and petroleum line) and southern fork of Midland fault trace

39. Intersection of State Route 113 and southern fork of Midland fault trace

40. Intersection of natural gas pipeline and northern fork of Midland fault trace

41. Intersection of natural gas pipeline and southern fork of Midland fault trace

42. Intersection of petroleum line and northern fork of Midland fault trace

43. Intersection of petroleum line and southern fork of Midland fault zone

44. Intersection of natural gas pipeline and Midland fault trace

45. Boundary of bay mud deposits

NOISE

DEFINITION AND MEASURE

Noise can be defined as unwanted or undesirable sound. However, what constitutes undesirable sound is difficult to define and often involves subjective evaluation. Noise and its effect on the listener is described in three dimensions: (1) frequency, (2) intensity, and (3) time (fluctuation).

The human ear is sensitive to a wide range of sound intensities. A logarithmic scale, called the decibel (dB), is used to represent this wide range. A given sound level in decibels describes the intensity or pressure level of sound waves traveling outward from a source. The threshold of human hearing corresponds roughly to zero dB.

Sound is usually measured in terms of its level in decibels above or below ambient level or an arbitrary reference quantity (often the faintest sound audible to the average healthy young person). When measuring urban noise, two of the three acoustic dimensions,

frequency and intensity are measured using a sound level meter with a special sound filter. This filter, called an A-weighting filter, measures only that noise which falls within a frequency range of 20-20,000 Hz (Hertz, or cycles per second of noise vibration). In monitoring a noise source, the A-weighted filter weighs all of the frequencies which are generated, and averages them to produce a single number, the A-weighted level. Table 9 shows the sound level of typical noise sources encountered in an urban environment.

A-weighting is incorporated in all sound level meters. The A-weighted scale accurately describes noise at a particular instant in time; however, urban noise is generated by both distant and near sources and varies continuously. Distant sources may include traffic, wind through trees, and industrial activity. These sources are fairly constant for short periods of time, but vary from hour to hour and day to day. Nearby sources such as a passing automobile or an aircraft overflight cause the urban noise level to fluctuate from moment to moment.

Changing noise is generally more disagreeable than steady noise. Currently, time variation in A-weighted noise is accounted for differently by various concerned government agencies (U. S. Department of Transportation, State of California Environmental Agency, Federal Aviation Administration, etc.).

The U. S. Department of Transportation accounts for the time-varying character of environmental noise statistically. The statistical descriptors are the A-levels or noise levels exceeded either 90, 50, or 10 percent of the time over a 24 hour day, designated L_{90}, L_{50}, or L_{10} = dB(A). L_{90} represents a good estimate of the background noise caused by distant sources. L_{50} is the average level and L_{10} is the "average peak" level caused by nearby sources of short duration. Each of these single number descriptors accounts for the three dimensions of urban noise: frequency, intensity, and time-varying characteristics.

The State of California Environmental Quality Agency accounts for the time variation of A-weighted noise by averaging all levels reached, and refers to these averages as Community Noise Equivalent Levels (CNELS). CNEL noise contours represent the average of all noise levels reached during a 24 hour day, adjusted to an equivalent level. This adjustment accounts for the lower tolerance of people to noise during evening and nighttime periods relative to the daytime periods.

TABLE 9. TYPICAL URBAN NOISE SOURCES AND LEVELS

Source	Decibels, A-weighted (dBA)
Civil defense siren @ 100 ft.	140
Jet takeoff @ 200 ft.	130
Riveting machine, rock music band	110
DC-10 flyover @ 700 ft., pile driver @ 50 ft.	100
Subway train @ 20 ft.	90
Garbage disposal in home @ 3 ft., inside sports car @ 50 mph	80
Freight train @ 100 ft., vacuum cleaner @ 10 ft., speech @ 1 ft.	70
Auto traffic near freeway, large store, accounting office	60
Large transformer, private business office, light traffic @ 100 ft.	50
Minimum levels - residential areas in San Francisco at night	40
Soft whisper @ 5 ft.	30
Rustling leaves, recording studio	20
Threshold of hearing in youth (1000 - 4000 Hz)	0

NOISE STANDARDS

The effects of noise on people can be grouped in three general categories:

1. Subjective effects of annoyance, nuisance, dissatisfaction;

2. Interference with activities such as speech, sleep, learning;

3. Physiological effects such as startle, hearing loss.

The sound levels associated with urban noise generally produce effects only in the first two categories. Yet, at any given level, individual responses will vary considerably. Annoyance, nuisance, dissatisfaction, and startle effects can happen at virtually any level. The response of an individual depends on such factors as time duration, frequency content, background noise level, and the hearer's activity at the time. A considerable amount of evidence has been compiled by the U.S. Environmental Protection Agency which correlates certain constant noise levels with speech interference, sleep disturbance, and hearing loss. The standards recommended in Tables 1 and 2 are based in part on this research.

The level identified for the protection of speech communication is 45 dB (CNEL) within the home. Allowing for a 15 dB reduction in ground level between outdoors and indoors, this level becomes an outdoor day-night sound level of 60 dB (CNEL) for residential areas. For outdoor voice communication, a day-night background noise level of 60 dB (CNEL) allows normal conversation at distances up to around six feet, but interferes with speech at a speaker-to-listener distance of about 12 feet. Long-term exposure to levels exceeding 70 dBA causes hearing loss.

Although speech interference has been identified as the primary noise conflict with human activity and as the principal reason for adverse community reactions to noise and long-term annoyance, a margin of safety of 5dB should be applied to the maximum outdoor level to give adequate weight to other adverse effects. Therefore, a L_{dn} level of 55 dB is identified by the Environmental Protection Agency as the maximum outdoor level in residential areas compatible with the protection of the public health and welfare. With respect to complaints and long-term annoyance, this level is clearly a maximum, satisfying a large majority of the population. However, specific local situations, attitudes, and conditions may make lower levels desirable for some locations.

The following general noise perception evaluations are accepted by noise experts:

1. Except in carefully controlled laboratory experiments, an increase of only one dB in A-Level cannot be perceived.

2. Outside of the laboratory, a three dBA increase is considered to be a barely noticeable difference.

3. A change of at least five dBA is required before any noticeable change in community response can be expected.

4. A ten dBA increase is subjectively heard as a doubling in loudness, and would almost certainly cause adverse response in the community.

PRESENT NOISE CONTOURS

Community Noise Equivalent Level (CNEL) contours have been plotted for the present and future (1995) in Figures 4 through 9. The principal source of noise in the planning area is vehicular traffic, followed by local airport and railroad operations.

Vehicular Traffic. U.S. Interstate Highway Routes 80, 505, 605, and 780, and California Routes 12, 29, 37, 84, 113, 141, and 220 are all major contributors to existing acoustical conditions in Solano County. Peak noise levels on these highways are accountable to truck traffic. Where these routes pass through Fairfield, Suisun, and Vacaville as local arterials, stop and go traffic contributes to peak noise levels. During evening hours, noise from vehicular traffic in the planning area remains at audible background levels.

Highway CNEL contours were plotted for highways based upon data on traffic counts and characteristics obtained from the California Department of Transportation, Stockton Division. Contours on local arterials were translated from traffic counts and roadway dimensions provided by the Cities of Fairfield and Vacaville.

Airport Operations. Aviation activities at Travis Air Force Base and Nut Tree Airport are the principal sources of aircraft noise in Solano County. Present noise contours indicated for Travis Air Force Base were adopted from mapped data made available by the U. S. Air Force, dated January, 1964. These contours represent the worst noise conditions that can be expected, according to Air Force personnel, since aircraft activity at the time of measurement was considerably greater than present levels. In 1964, Travis AFB was providing major support for military actions in Southeast Asia. Base personnel estimate that air traffic in 1964 exceeded present levels by roughly 500 percent. Furthermore, the types of aircraft operating out of Travis at that time included Strategic Air Command (SAC) B-52's, a significantly noisier aircraft than those flying in and out of Travis today, including the C5A Galaxy. SAC activities have since been discontinued at Travis AFB. (See pages 18 and 68 for further comments regarding Travis AFB noise contour data.)

Adaptions were made to Air Force contour maps by the consultants to show contours as CNEL's and to extend contours to CNEL 45.

Present CNEL contours as indicated for the Nut Tree Airport were mapped from the recently completed Nut Tree Airport Environmental Impact Assessment Report by August W. Compton and Associates, 1974.

Railroad Operations. Train passages are a major contributor to peak noise levels through the central portion of Solano County, especially in areas where railway lines run parallel to highways. Train passages on Southern Pacific's A, AA and AD lines (see Figures 4 and 7) are heard intermittently throughout the day and night. Passages on the Southern Pacific's AAB line and on the Sacramento Northern Lines in the county are much more intermittent and do not appreciably effect the noise environment. CNEL contours due to railway traffic were calculated by the consultants from information obtained from the Southern Pacific Transportation Company, and methods outlined in Assessment of Noise Environments Around Railroad Operations (Swing, July, 1973).

PLANNING AREA CASE STUDIES

A series of case studies were prepared by the consultant as a part of the evaluation of existing conditions for Solano County and the cities of Fairfield, Vacaville, and Suisun City. During the morning and afternoon of August 11, 1975, noise measurements were made at six locations in the cities of Fairfield and Vacaville. The data was measured using the methodology described in the accompanying Appendix C.

Site #1: Located in the backyard of a home at 488 Manzanita Street, about 150 feet south of I-80.

Time: 8:35 A.M.

Background Sources: Distant traffic.

Peak Sources: Traffic on I-80.

Measurements: L_{10}=75; L_{50}=68; L_{90}=62.

The CNEL at this location is estimated to be about 75, significantly exceeding the recommended maximum level standard of CNEL 65 for residential environmental noise.

Site #2: Located at a vacant lot about 1-1/2 miles north of Airbase Parkway on the south side of I-80.

At Site #2, an evaluation was made of the noise reduction provided by the masonry wall built along I-80 to shield an FHA-financed housing development located several hundred feet from the freeway. The data recorded at Site #2 reflects the approximate noise level in the backyards of the FHA homes.

Time: 9:04 - 9:14 A.M.

Background Sources: Distant traffic, cars on I-80.

Peak Sources: Trucks on I-80.

Measurements: $L_{10} = 69$; $L_{50} = 65$; $L_{90} = 62$.

Based on this data, CNEL is estimated to be about 69. Although the wall is 13 feet high, it still does not shield the homes from one of the loudest highway noise sources, the exhaust of the diesel trucks. An effective noise barrier must completely break the line-of-sight between the source of noise and the receiver. This wall blocks the line-of-sight to two significant highway noise sources, tire-roadway interaction of cars and trucks and the engine noise of the trucks, but does not block sight of truck exhausts. Since truck exhausts account for much of the noise level generated on I-80, the wall is not an adequate noise barrier. To test the maximum noise reduction that could be provided by the wall, highway noise was monitored from a creek bed 50 feet from the wall (Site #3), thereby completely breaking the line-of-sight between the listener and the truck exhausts.

Site #3: Creek bed about 50 feet from FHA-required wall.

Time: 9:20 - 9:30 A.M.

Background Sources: Distant traffic.

Peak Sources: Traffic on I-80.

Measurements: $L_{10} = 65$; $L_{50} = 60$; $L_{90} = 56$.

Surprisingly, the L_{10} at the creekbed had not been reduced by more than four decibels. However, the less than expected reduction may be the result of sound leakage through the cracks in the wall and around the ends of the wall. As presently designed, the wall probably reduces traffic noise by somewhere between 5 and 10 dB. If it were increased in height and length, the wall could achieve a maximum noise reduction of about 15 dB.

Site #4: Located in front of 1302 Pennsylvania Avenue near Grant in Fairfield, about 15 feet from the center of the near lane.

Time: 11:15 - 11:25 A.M.

Background Sources: Dogs barking, leaves rustling and distant traffic.

Peak Sources: Automobiles on Pennsylvania Avenue.

Measurements: L_{10}= 72; L_{50} =61; L_{90} = 55.

At this location, the 24-hour CNEL is probably around 70, and in the front yards of the homes along this street, the level probably ranges between 68 and 70 CNEL.

Site #5: Located on Alamo Drive in Vacaville near Danfield, about 27 feet from the center of the near lane, at property line of new apartment building called Alamo South Unit 6.

Time: 11:55 A.M. - 12:05 P.M.

Background Sources: Distant traffic, children playing.

Peak Sources: Through traffic on Alamo and stop-and-go traffic on Danfield.

Measurements: L_{10} =70; L_{50} =62; L_{90} = 52.

At this location, CNEL was approximately 68 dB.

Site #6: Located in parking lot adjacent to 2-story apartment building at 519 East Monte Vista near Hillside.

Time: 12:35 - 12:45 P.M.

Background Sources: Distant traffic.

Peak Sources: Through traffic on East Monte Vista and people talking nearby.

Measurements: L_{10} =73; L_{50} = 67; L_{90} =58.

At this location, the CNEL is approximately 71 dB.

In addition to the aforementioned measurements, Peabody Road was field-checked south of the intersection with Elmira and south of its intersection with California Drive. Traffic noise on Elmira east of Peabody was also field-checked. The project noise consultants felt that the evident noise exposure for housing in these areas also exceeded acceptable levels.

FUTURE NOISE CONTOURS

Vehicular Traffic. Noise due to vehicular traffic will rise substantially in many areas of Solano County by the design year 1995. By 1995, CALTRANS District 10 expects a reduction in speed on many sections of U.S. Interstate 80 of approximately 20 m.p.h. These estimated speed reductions are based upon a traffic forecast for the route of nearly twice present volumes. Similar increases are expected on many other highways in Solano County. No current projections were available concerning future average daily traffic counts on major arterials in Fairfield, Suisun City, and Vacaville. Therefore, future noise contours were predicated on the basis of each arterial's maximum traffic capacity and probable level of usage by trucks. As vehicle noise mitigation technology improves, and with the continued enforcement of the California Motor Vehicle Noise Standards, traffic noise levels could decrease by as much as 5 dB from those presently predicted for the future, as mapped on Figures 7, 8 and 9.

Aircraft operations. Peak day operations from Nut Tree Airport are projected to rise from an estimate of 666 operations in 1974 to a forecast of 1100 operations in 1994. Future CNEL contours as mapped for Nut Tree Airport are from the Nut Tree Airport Environmental Impact Assessment Report by August W. Compton and Associates, 1974.

Future and present CNEL contours for Travis Air Force Base are not available at this time. Later this year, a set of contours will be available. Assuming no major change in mission, the CNEL contours should be approximately equal to present contours and should be somewhat less than those mapped from 1964 data. When Travis' future contours become available, they should be reviewed to determine any changes from current forecasts and Figure 7 should be revised accordingly.

Railroad Operations. Southern Pacific Transportation Company predicts no sizeable increase in rail operations in Solano County in the future on its main lines. However, with the present energy crisis, Amtrak and freight activities could change appreciably at any time. When the Busch plant which will be served by S.P.'s AA Line commences operation, there will be a considerable amount of switching on a 24-hour basis. Exact figures, however, are not available at this time. And finally, proposals for commuter runs along S.P. tracks between San Francisco and Sacramento are becoming increasingly feasible with the incipient fuel situation. Such commute provisions would increase traffic frequency through Solano County, perhaps significantly.

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APPENDIX

APPENDIX A — THE MERCALLI INTENSITY SCALE

(As modified by Charles F. Richter in 1956 and rearranged)

If most of these effects are observed	*then the intensity is:*
Earthquake shaking not felt. But people may observe marginal effects of large distance earthquakes without identifying these effects as earthquake-caused. Among them: trees, structures, liquids, bodies of water sway slowly, or doors swing slowly.	I
Effect on people: Shaking felt by those at rest, especially if they are indoors, and by those on upper floors.	II
Effect on people: Felt by most people indoors. Some can estimate duration of shaking. But many may not recognize shaking of building as caused by an earthquake; the shaking is like that caused by the passing of light trucks.	III
Other effects: Hanging objects swing. *Structural effects:* Windows or doors rattle. Wooden walls and frames creak.	IV
Effect on people: Felt by everyone indoors. Many estimate duration of shaking. But they still may not recognize it as caused by an earthquake. The shaking is like that caused by the passing of heavy trucks, though sometimes, instead, people may feel the sensation of a jolt, as if a heavy ball had struck the walls. *Other effects:* Hanging objects swing. Standing autos rock. Crockery clashes, dishes rattle or glasses clink. *Structural effects:* Doors close, open or swing. Windows rattle.	V
Effect on people: Felt by everyone indoors and by most people outdoors. Many now estimate not only the duration of shaking but also its direction and have no doubt as to its cause. Sleepers wakened. *Other effects:* Hanging objects swing. Shutters or pictures move. Pendulum clocks stop, start or change rate. Standing autos rock. Crockery clashes, dishes rattle or glasses clink. Liquids disturbed, some spilled. Small unstable objects displaced or upset. *Structural effects:* Weak plaster and Masonry D* crack. Windows break. Doors close, open or swing.	VI
Effect on people: Felt by everyone. Many are frightened and run outdoors. People walk unsteadily. *Other effects:* Small church or school bells ring. Pictures thrown off walls, knicknacks and books off shelves. Dishes or glasses broken. Furniture moved or overturned. Trees, bushes shaken visibly, or heard to rustle. *Structural effects:* Masonry D* damaged; some cracks in Masonry C*. Weak chimneys break at roof line. Plaster, loose bricks, stones, tiles, cornices, unbraced parapets and architectural ornaments fall. Concrete irrigation ditches damaged.	VII
Effect on people: Difficult to stand. Shaking noticed by auto drivers. *Other effects:* Waves on ponds; water turbid with mud. Small slides and caving in along sand or gravel banks. Large bells ring. Furniture broken. Hanging objects quiver. *Structural effects:* Masonry D* heavily damaged; Masonry C* damaged, partially collapses in some cases; some damage to Masonry B*; none to Masonry A*. Stucco and some masonry walls fall. Chimneys, factory stacks, monuments, towers, elevated tanks twist or fall. Frame houses moved on foundations if not bolted down; loose panel walls thrown out. Decayed piling broken off.	VIII
Effect on people: General fright. People thrown to ground. *Other effects:* Changes in flow or temperature of springs and wells. Cracks in wet ground and on steep slopes. Steering of autos affected. Branches broken from trees. *Structural effects:* Masonry D* destroyed; Masonry C* heavily damaged, sometimes with complete collapse; Masonry B* is seriously damaged. General damage to foundations. Frame structures, if not bolted, shifted off foundations. Frames racked. Reservoirs seriously damaged. Underground pipes broken.	IX
Effect on people: General Panic. *Other effects:* Conspicuous cracks in ground. In areas of soft ground, sand is ejected through holes and piles up into a small crater, and, in muddy areas, water fountains are formed. *Structural effects:* Most masonry and frame structures destroyed along with their foundations. Some well-built wooden structures and bridges destroyed. Serious damage to dams, dikes and embankments. Railroads bent slightly.	X
Effect on people: General panic. *Other effects:* Large landslides. Water thrown on banks of canals, rivers, lakes, etc. Sand and mud shifted horizontally on beaches and flat land. *Structural effects:* General destruction of buildings. Underground pipelines completely out of service. Railroads bent greatly.	XI
Effect on people: General panic. *Other effects:* Same as for Intensity X. *Structural effects:* Damage nearly total, the ultimate catastrophe. *Other effects:* Large rock masses displaced. Lines of sight and level distorted. Objects thrown into air.	XII

* Masonry A: Good workmanship and mortar, reinforced, designed to resist lateral forces.
Masonry B: Good workmanship and mortar, reinforced.
Masonry C: Good workmanship and mortar, unreinforced.
Masonry D: Poor workmanship and mortar and weak materials, like adobe.

from Calif. Div. of Mines and Geology Bull. 198

APPENDIX B

NOTICE TO BUILDING PERMIT APPLICANTS RE: EXPANSIVE SOIL CONDITIONS

Expansive soil conditions are found in many parts of the planning area and are the cause of considerable damage to residential construction. These soils tend to swell considerably when wet and shrink and crack when dry. Non-uniform shrink/swell behavior causes foundation cracking and general settlement. Related heave may throw wood frames out of plumb.

Where expansive soils are present, the Building Official recommends and may require that applicants submit evidence of adequate soil and structural engineering measures aimed at preventing or minimizing expansive soil damage. Where this requirement is waived because of the small size of the project or hardship considerations, the following minimum design provisions are recommended to reduce expansive soil damage to conventional residential structures:

1. Pier and grade beam foundations, or conventional footings shall extend to a depth of at least 30 inches.

2. Use of slab-on-grade construction shall be avoided, especially in living areas, since cracking, heaving, or settling of such slabs are common.

3. Water shall not be allowed to collect or pond near foundation or slabs.

4. Swimming pools and decks are especially vulnerable to shrink-swell related problems. Swimming pool contractors shall use a pool design which contains special provisions for expansive soil conditions.

The foregoing precautions will not necessarily prevent all damage due to expansive soils, but will minimize some of the most common problems.

APPENDIX C

NOISE MEASUREMENT PROCEDURE AND FIELD INSTRUMENTATION

A Bruel and Kjaer (B&K) Model 166/S.45 Environmental Noise Classifier was used to monitor the outdoor environment in the Study Area. The Model 166/S.45 is a self-contained instrument which can be used to obtain the statistical distribution of environmental noise. It divides the noise level into eleven amplitude classes and one exceedance class (alternating class widths of 2 dB and 3dB). The baseline of the analysis (the lower limit of the lowest amplitude class) can be set from 60 dBA to 100dBA in nine 5-dBA steps with an additional setting at 45 dBA. The dynamic range of the instrument is 30 dBA. A twelve-volt battery and a Tripp-Lite power inverter were used to power the equipment during the measurements.

A General Radio (GR) Model 1565B Sound Level Meter verified that the B&K 166/S.45 was operating in the correct range. Then the signal from the sound level meter was fed into the B&K 166/S.45 (instead of using the microphone input directly into the B&K 166/S.45) in order to establish a clearer signal by which low noise levels may be more accurately measured.

The instrumentation was calibrated before, during, and after the survey with a GR 1562-A sound level calibrator. The calibrator tone was a sound pressure level of 114 dB re 2×10^{-5} N/m^2 at a frequency of 1000 Hz.

The following is a complete list of our field measurement instrumentation with serial numbers:

Bruel and Kjaer Environmental Noise Classifier
Model 166/S.45 Serial No. 179

Bruel and Kjaer Windscreen
Model UA-0207

General Radio Sound Level Calibrator
Type 1562-A Serial No. 9086

Tripp-Lite Power Verter
Model PV-100

Viking Battery Charger
Model VA 7612

6-Foor Miniture Phone Plug to BNC Cable

Trojan 12-volt Batteries
Type R-24M

Teac Headphones

Bacharach Slign Psychrometer
Model 12-2006

Dwyer Wind Meter

Bruel and Kjaer Tripod

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